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Sajo, Prof. Karl, Gödöllö-Veresegyház, Hungary.

Schoyen, Prof. W. M., Zoölogical Museum, Christiania, Norway.

Shipley, Prof. Arthur E., Christ's College, Cambridge, England.

Silvestri, Dr. F., R. Scuola Superiore di Agricoltura, Portici, Italy.

Tepper, J. G. O., Norwood, South Australia.

Theobald, Frederick V., Wye Court, Wye, Kent, England.

Thompson, Rev. Edward H., Franklin, Tasmania.

Tryon, H., Queensland Museum, Brisbane, Queensland, Australia.

Urich, F. W., Victoria Institute, Port of Spain, Trinidad, West Indies.

Vermorel, V., Station Viticole, Villefranche, Rhone, France.

Plate 1 (Frontispiece)

American Association of Economic Entomologists
Baltimore, Md., Dec. 28, 1908

EXPLANATION OF PLATE I (FRONTISPIECE)

1 W. A. Hooker.
2 J. G. Sanders.
3 W. E. Hinds.
4 E. P. Felt.
5 E. R. Sasscer.
6 W. F. Fiske.
7 W. D. Hunter.
8 R. A. Vickery.
9 C. L. Marlatt.
10 G. G. Ainslie.
11 E. O. G. Kelly.
12 E. S. G. Titus.
13 H. T. Fernald.
14 H. Garman.
15 A. F. Satterthwait.
16 E. A. Schwarz.
17 R. L. Webster.
18 W. H. Goodwin.
19 G. M. Bentley.
20 C. N. Ainslie.
21 W. S. Fisher.
22 F. M. Webster.
23 P. J. Parrott.
24 C. W. Hooker.
25 E. L. Jenne.
26 G. D. Schafer.
27 Harry S. Smith.
28 Paul Hayhurst.
29 C. H. Popenoe.
30 H. T. Osborn.
31 Franklin Sherman, Jr.
32 Paul R. Jones.
33 A. G. Ruggles.
34 Z. P. Metcalf.
35 S. A. Forbes.
36 E. L. Worsham.
37 E. C. Cotton.
38 F. L. Washburn.
39 B. M. Chatterjee.
40 W. C. O'Kane.
41 N. E. Shaw.
42 Herbert Osborn.
43 Edith M. Patch.
44 H. E. Summers.
45 J. S. Hine.
46 H. A. Gossard.
47 J. L. Randall.
48 S. C. Clapp.
49 E. F. Hitchings.
50 J. B. Smith.
51 W. E. Rumsey.
52 L. Bruner.
53 A. F. Burgess.
54 W. E. Britton.
55 A. D. Hopkins.
56 W. D. Pierce.
57 J. L. Phillips.
58 F. E. Brooks.
59 H. F. Wilson.
60 C. E. Hood.
61 H. E. Hodgkiss.
62 V. L. Wildermuth.
63 J. F. Zimmer.
64 H. M. Russell.
65 L. M. Peairs.
66 R. W. Braucher.
67 E. F. Phillips.
68 H. P. Wood.
69 T. B. Symons.
70 R. H. Pettit.
71 E. D. Sanderson.
72 C. R. Crosby.
73 W. M. Wheeler.

JOURNAL

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OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

VOL. 2 FEBRUARY, 1909 No. 1

Proceedings of the Twenty-first Annual Meeting of the American Association of Economic Entomologists

The twenty-first annual meeting of the American Association of Economic Entomologists was held at the Eastern Female High School, Baltimore, Maryland, December 28 and 29, 1908.

Part I of this report contains the business proceedings, while the addresses, papers and discussions will be found in Part II.

PART I

The meeting was called to order by President S. A. Forbes at 10 a. m. on Friday, December 28. The attendance was larger than at any previous meeting of the Association and averaged over 100 at each session. The following members were present:

C. N. Ainslie, Washington, D. C.; George G. Ainslie, Clemson College, S. C.; H. S. Barber, Washington, D. C.; G. M. Bentley, Knoxville, Tenn.; R. W. Braucher, Washington, D. C.; W. E. Britton, New Haven, Conn.; Fred E. Brooks, Morgantown, W. Va.; Lawrence Bruner, Lincoln, Neb.; A. F. Burgess, Washington, D. C.; August Busck, Washington, D. C.; J. H. Comstock, Ithaca, N. Y.; Mel. T. Cook, Newark, Del.; R. A. Cooley, Bozeman, Mont.; E. C. Cotton, Knoxville, Tenn.; F. D. Couden, Washington, D. C.; J. C. Crawford, Washington, D. C.; C. R. Crosby, Ithaca, N. Y.; R. P. Currie, Washington, D. C.; E. P. Felt, Albany, N. Y.; H. T. Fernald, Amherst, Mass.; W. F. Fiske, Washington, D. C.; S. A. Forbes, Urbana, Ill.; H. L. Frost, Arlington, Mass.; A. B. Gahan, College Park, Md.; H. Garman, Lexington, Ky.; B. N. Gates, Washington, D. C.; A. A. Girault, Urbana, Ill.; W. H. Goodwin, Wooster, Ohio; H. A. Gossard, Wooster, Ohio; A. G. Hammar, Washington, D. C.; Paul Hayhurst, Boston, Mass.; Otto Heidemann, Washington, D. C.; W. E. Hinds, Auburn, Ala.; J. S. Hine, Columbus, Ohio; E. F. Hitchings, Augusta, Me.; H. E. Hodgkiss, Geneva, N. Y.; C. E. Hood, Dallas, Texas; C. W. Hooker,

Amherst, Mass.; W. A. Hooker, Washington, D. C.; A. D. Hopkins, Washington, D. C.; C. O. Houghton, Newark, Del.; L. O. Howard, Washington, D. C.; W. D. Hunter, Washington, D. C.; E. L. Jenne, Washington, D. C.; P. R. Jones, Washington, D. C.; E. O. G. Kelly, Washington, D. C.; Frederick Knab, Washington, D. C.; E. J. Kraus, Washington, D. C.; C. L. Marlatt, Washington, D. C.; Herbert Osborn, Columbus, Ohio; P. J. Parrott, Geneva, N. Y.; Edith M. Patch, Orono, Me.; L. M. Peairs, College Park, Md.; R. H. Pettit, Agricultural College, Mich.; E. F. Phillips, Washington, D. C.; J. L. Phillips, Blacksburg, Va.; W. D. Pierce, Washington, D. C.; C. H. Popenoe, Washington, D. C.; A. L. Quaintance, Washington, D. C.; J. L. Randall, California, Pa.; W. A. Riley, Ithaca, N. Y.; A. G. Ruggles, St. Anthony Park, Minn.; W. E. Rumsey, Morgantown, W. Va.; H. M. Russell, Washington, D. C.; J. G. Sanders, Washington, D. C.; E. D. Sanderson, Durham, N. H.; E. R. Sasscer, Washington, D. C.; A. F. Satterthwait, Harrisburg, Pa.; E. A. Schwarz, Washington, D. C.; W. M. Scott, Washington, D. C.; G. D. Shafer, East Lansing, Mich.; N. E. Shaw, Columbus, Ohio; Franklin Sherman, Jr., Raleigh, N. C.; Henry Skinner, Philadelphia, Pa.; M. V. Slingerland, Ithaca, N. Y.; H. S. Smith, Washington, D. C.; J. B. Smith, New Brunswick, N. J.; R. I. Smith, West Raleigh, N. C.; A. E. Stene, Kingston, R. I.; H. E. Summers, Ames, Iowa; T. B. Symons, College Park, Md.; E. P. Taylor, Mountain Grove, Mo.; E. S. G. Titus, Logan, Utah; C. H. T. Townsend, Washington, D. C.; R. A. Vickery, Washington, D. C.; H. L. Viereck, Detroit, Mich.; F. L. Washburn, St. Anthony Park, Minn.; J. L. Webb, Washington, D. C.; F. M. Webster, Washington, D. C.; R. L. Webster, Ames, Iowa; W. M. Wheeler, Boston, Mass.; H. F. Wilson, Washington, D. C.; H. P. Wood, Dallas, Texas; and E. L. Worsham, Atlanta, Ga.

Among the visitors were noted the following:

J. C. Bradley, Ithaca, N. Y.; B. M. Chatterjee, Ithaca, N. Y.; S. C. Clapp, Raleigh, N. C.; Mrs. Anna B. Comstock, Ithaca, N. Y.; W. S. Fisher, Harrisburg, Pa.; P. H. Hertzog, Lewisburg, Pa.; John D. Evans, Trenton, Ontario; Charles W. Johnson, Boston, Mass.; Z. P. Metcalf, Raleigh, N. C.; Aven Nelson, Laramie, Wyo.; W. C. O'Kane, Columbus, Ohio; H. T. Osborn, Columbus, Ohio; Mrs. H. S. Smith, Washington, D. C.; V. L. Wildermuth, Columbus, Ohio, and J. F. Zimmer, Columbus, Ohio.

The report of the Secretary was read as follows:

REPORT OF THE SECRETARY

The year just closing has been a prosperous one for this Association; the only sad feature having been our loss by death of five members. While the work and personality of each of these former members was held in high esteem by the members of the Association, and will undoubtedly be given proper attention by the Committee on Resolutions at this meeting, it seems but fitting to make special mention of our great loss in the death of Dr. James Fletcher, Government Entomologist of the Dominion of Canada, who was one of the prime movers in forming this Association. His interest in our organization never wavered and his words of good cheer and encouragement, especially to the young men who were just beginning their career

in entomology, will never be forgotten by any who had the privilege of his acquaintance.

Twenty-three associate and three foreign members were elected at the last annual meeting. One active and four associate members were dropped from the roll at that meeting and these with one active and two associate members that have resigned and three active and two associate members that have died, leave the total membership 252, a net gain for the year of 13.

In accordance with a resolution passed at the last annual meeting application blanks for membership have been printed. Twenty-seven applications for membership have been received by the secretary and two recommendations for foreign membership.

By direction of the Association the Secretary compiled a complete list of the accepted common names of insects, which was published in the JOURNAL and separates were sent to a list of nearly 700, including members of this Association, the Entomological Society of America and the Agricultural Press.

The correspondence during the year has increased rapidly and the work required in connection with the JOURNAL has taken much time.

An arrangement was made with the officers of the American Association of Horticultural Inspectors to have the meeting of that association held during the week that our meeting is in session. This should be of great advantage to all concerned.

FINANCIAL STATEMENT

Balance on hand, December 27, 1907			$50.12
By amount received for dues, 1908			138.50
To printing programs, 1907	$15.50		
letter-heads and envelopes	9.00		
membership application blanks	2.50		
constitution and notices	11.25		
programs, 1908	5.70		
Typewriting annual report and copies	9.00		
Copy and carbon paper	2.00		
Express on manuscript	.50		
Telegram	.35		
Postage	32.50		
Seven hundred (700) reprints common names of insects	6.90		
Committee on Nomenclature	1.85	$97.05	
Balance in treasury	91.57		
	$188.62		$188.62

The balance in the treasury which has accumulated during the past two years has been due to the fact that no stenographer has been secured to report the meetings, as was authorized by the Association. Two reasons have been responsible for this, viz., insufficient funds and inability to secure a satisfactory stenographer at the points where the meetings were held. Provision has been made for reporting the meeting this year and the expenditures next year will probably nearly equal the receipts.

Respectfully submitted,

A. F. BURGESS, *Secretary.*

By vote of the Association the report was accepted and the financial statement referred to the Auditing Committee for a later report.

The Secretary requested that some action be taken by the Association concerning the fund in the treasury; whether it should be

drawn upon for committee or similar work or held intact with the possible view of taking over the JOURNAL OF ECONOMIC ENTOMOLOGY.

He then read the list of applications for membership which were referred to the Committee on Membership.

The report of the Committee on Constitution was presented by Mr. J. B. Smith, who stated that the constitution had been revised and that copies had been mailed to the members so that action could be taken at the meeting. He explained that the principal changes were in more carefully defining the classes of membership and method of electing new members.

The Constitution as adopted follows and a summary of the discussion is added:

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

CONSTITUTION

ARTICLE I

Name and Objects

SECTION 1. This association shall be known as the American Association of Economic Entomologists.

SECT. 2. Its objects shall be: (1) To discuss new discoveries, to exchange experiences, and to carefully consider the best methods of work in economic entomology; (2) to give opportunity to individual workers of announcing proposed investigations so as to bring out suggestions and avoid unnecessary duplication of work; (3) to suggest, when possible, certain lines of investigation upon subjects of general interest; (4) to promote the study and advance the science of entomology.

ARTICLE II

Membership

SECTION 1. The membership shall be confined to workers in economic entomology. All economic entomologists employed by the General or State governments or by the State experiment stations, or by any agricultural or horticultural association, and all teachers of economic entomology in educational institutions and other persons engaged in practical work in economic entomology may become members.

SECT. 2. The classes of membership shall be active, associate and foreign. Active membership shall be conferred only on persons who have been trained in entomological work and whose practical experience or published papers have evidenced their ability to conduct original investigations in economic entomology.

SECT. 3. Associate membership may be conferred on persons who have done general or practical work in entomology and who have by published papers or otherwise, given evidence of their attainments in such work.

SECT. 4. Foreign membership shall be honorary and shall apply only to members residing outside of the United States and Canada.

SECT. 5. Associate and foreign members shall not be entitled to hold office or to vote.

SECT. 6. Membership, other than foreign membership, may be conferred at any regular meeting by a two-thirds vote of the members present upon recommendation of the committee on membership, after a regular application endorsed by two active members has been filed with the Secretary.

SECT. 7. Foreign members may be proposed in writing by any active member and their names shall be acted upon by the committee on membership and the Association as in the case of other members.

ARTICLE III

Officers

SECTION 1. The officers shall consist of a president, two vice-presidents, who shall be elected annually, and a secretary who shall be elected for a term of three years, who shall perform the duties customarily incumbent upon their respective offices and as defined in the by-laws. The above officers shall act as an executive committee and shall pass on any urgent matters that cannot be deferred until the annual meeting. The president shall not hold office for two consecutive terms. Immediately after election he shall appoint a committee on membership, consisting of three members, who shall serve during his term of office, and who shall carefully examine the membership roll and the applications for membership and report its recommendations to the association for action at a regular meeting.

ARTICLE IV

Annual Meeting—Quorum

SECTION 1. The annual meeting shall be held at such time and place as may be decided upon by the association at the previous annual meeting and special meetings may be called by order of the executive committee. Twenty members shall constitute a quorum for the transaction of business.

ARTICLE V

Amendments

SECTION 1. All proposed alterations or amendments to this constitution shall be referred to a committee of three at any regular meeting, and after a report from such committee, may be adopted by a two-thirds vote of the members present; *Provided*, That a written notice of the proposed amendment has been sent to every active member of the association at least one month prior to the date of action.

BY-LAWS

ARTICLE I

Of Members

SECTION 1. The classes of members are defined in the constitution as are their rights to vote or hold office. Members of all kinds have equal privi-

leges as to presentation of papers and in scientific discussions at the regular meetings, and may, by permission of the presiding officer, speak on business questions before the association.

SECT. 2. All members in good standing have equal rights to the publications of the association or to any publications controlled or distributed by the association.

ARTICLE II

Of Officers and Their Duties

SECTION 1. It shall be the duty of the president, in addition to the ordinary duties of the presiding officer, to prepare an address, to be delivered at the annual meeting over which he presides. He shall also appoint the necessary committees at the first session of the annual meeting.

SECT. 2. It shall be the duty of the secretary to make the necessary arrangements for the meetings of the association and keep a record of the proceedings for publication, to provide the necessary stationery and attend to the general correspondence. He shall collect moneys due, pay all bills incurred by the association, submit a report at each annual meeting, and perform such other duties as may be delegated to him.

SECT. 3. All officers and standing committees unless otherwise provided for shall be elected by ballot after recommendations have been made by a nominating committee.

ARTICLE III

Dues

SECTION 1. The annual dues of active members shall be One ($1.00) dollar, and the dues of associate members Fifty (50c) cents, which shall be payable in advance. No dues shall be payable from foreign members.

ARTICLE IV

Of Meetings

SECTION 1. Notice of the time and place of meetings shall be sent for publication to all American entomological periodicals. The proceedings shall be published as decided by the association.

SECT. 2. Special meetings shall be called as provided for in the constitution, and notice of such meetings shall be given by the secretary by mailing to each active member a formal notification of the time and place of the meeting at least two weeks before the date fixed in the notice. The notice shall state the reason for such meeting, and shall specify the business to be transacted, and no other business shall be transacted.

SECT. 3. The order of business at regular meetings shall be, at the first session:

1. Calling the meeting to order by the president.
2. Reports of officers.
3. Reports of committees.
4. Appointment of temporary committees.
5. Written business communications.
6. Verbal business communications.
7. New business.

8. Annual address of the president.
9. Program of papers and discussions.
10. Adjournment.

At the following session:

1. Discussion of the president's address.
2. Program of papers and discussions.

At the following sessions:

1. Program of papers and discussions.

Business can only be introduced at these sessions by vote of the association.

At the last regular session:

1. Program of papers and discussions.
2. Reports of appointed committees.
3. Miscellaneous business.
4. Election of officers.
5. Fixing time and place of next meeting.
6. Adjournment.

ARTICLE V

Amendments to By-Laws

SECTION 1. Changes in these by-laws may be made by a two-thirds vote at any regular meeting; *Provided,* Notice in writing of the proposed amendment be sent to every active member at least two weeks before the date of the meeting, at which it can come up for consideration.

Mr. Hopkins stated that he thought it undesirable to place the word "American" before the name of the Association, and was in favor of making the foreign members active members rather than to change the name of the Association.

Mr. J. B. Smith explained that the reason for placing "American" before the name of the Association was that it seemed absurd to have a class of foreign members unless the Association itself was limited to some specific area or country. Some time ago when certificates of membership were authorized to be given to foreign members it was necessary to designate the home of the Association in some way, and the committee that prepared the certificates took the liberty of placing the word "American" in them for that purpose. Our foreign members are honorary members and are elected because this Association wishes to recognize their standing as economic entomologists. Most of these men would not apply for active membership, so that they would never come into correspondence with us directly. They have little opportunity of meeting with us, but in case they do they have all the privileges of active members. We cannot reasonably ask members which we have elected in this way to pay dues but this would have to be done if they were made active members. It would be

necessary to change the whole tenor of the constitution if a change in the classes of membership was made.

A motion to strike out the word "American" in the title of the Association was lost.

The constitution and by-laws were then taken up section by section and passed with a few minor changes. In the by-laws under order of business for the first session the time for the presentation of the presidential address was changed so that it will follow the routine business.

By vote of the Association the constitution and by-laws were then adopted to take effect January 1, 1909, and the Secretary was authorized to entitle the various articles and sections of the constitution.

The Report of the Committee on National Control of Introduced Insect Pests, by Mr. Wilmon Newell, was read by the Secretary, as follows:

REPORT OF THE JOINT COMMITTEE ON LEGISLATION

To the Association of Economic Entomologists:

At the 18th Annual Meeting of this Association your correspondent was appointed to represent this body upon a Joint Legislative Committee, to be composed of one member from each the Association of Official Horticultural Inspectors, American Association of Nurserymen and the Association of Economic Entomologists.

At the 19th Annual Meeting, held at Chicago December 27 and 28, 1907, resolutions which had been agreed upon by the representatives of all three of these organizations were presented and adopted, and your correspondent continued as a member of the Joint Committee. The resolutions adopted by the Association at the Chicago meeting are appended hereto, labelled "Exhibit A." (They were published in the JOURNAL OF ECONOMIC ENTOMOLOGY, Feb., 1908, 1: 3-4.)

The same resolutions were approved by the Association of Official Horticultural Inspectors at Chicago and it then remained for the American Association of Nurserymen to take action on them at its meeting held at Milwaukee on June 10, 1908.

The member of the Joint Committee for the Association of Nurserymen, Mr. Orlando Harrison, made an extended canvass of the nurserymen early in 1908 to sound their views upon legislation looking to a uniform national inspection law and suitable inspection of imported nursery stock. The full report of Mr. Harrison to the American Association of Nurserymen is attached hereto, labelled "Exhibit B." (It was published in the JOURNAL OF ECONOMIC ENTOMOLOGY, Aug., 1908, 1: 270-73), and it was unanimously adopted by that organization. Briefly stated, the Association of Nurserymen refused to entertain any further consideration of a national inspection law or to endorse any further efforts towards securing one. The Association did, however, endorse thorough inspection of imported nursery stock.

In view of this attitude of the nurserymen towards a uniform inspection law, your representative would respectfully recommend that the Association

of Economic Entomologists waste no more time in trying to secure legislation of this character, unless it be requested by organizations representing fruit growers rather than nurserymen. It may be suggested, however, that this Association tender its support to the American Association of Nurserymen in securing any proper legislation intended to prevent additional importations of insect pests and looking to the control or eradication of such pests by the national government when unwittingly introduced.

Your correspondent is a firm believer in the doctrine, advocated years ago by several leading entomologists, that the duty of the professional entomologist ceases when he has called attention to any impending danger or has indicated in a conservative manner what legislation is needed to meet an existing condition. It is not his place, nor the place of this Association, to secure the passage of laws for people who do not want them.

Your correspondent further recommends and asks that the member of the Joint Committee on Legislation be discharged.

Respectfully submitted,

WILMON NEWELL,
Member Joint Committee.

Baton Rouge, La., December 21, 1908.

By vote of the Association the report was accepted and the recommendations adopted.

The report of the committee appointed to attend the Annual Meeting of the American Association of Nurserymen was presented by Mr. T. B. Symons.

REPORT OF THE COMMITTEE APPOINTED TO ATTEND THE MEETING OF THE AMERICAN ASSOCIATION OF NURSERYMEN

Mr. President:

Your committee begs leave to submit the following report: The Chairman, Dr. S. A. Forbes, being unable to attend the meeting of the Nurserymen's Association, the committee was represented by the other members, Messrs. Burgess and Symons.

A copy of the report of Mr. Orlando Harrison, Chairman of the Joint Committee on Legislation, consisting of representatives of nurserymen, entomologists and inspectors, which was submitted to the Nurserymen's Association, together with other resolutions passed by the Association bearing on legislation, was published in the fourth number of the JOURNAL OF ECONOMIC ENTOMOLOGY[1], which no doubt most of the members of this Association have seen. If desired, I would be glad to read this report and resolutions. Briefly, it may be stated that no definite action was taken by the Nurserymen's Association save the passing of a resolution authorizing the vice-presidents in each state to use all reasonable endeavor to have any drastic legislation now in force in his state modified to conform to the laws of other states, the practical workings of which have not entailed undue hardship to the nurserymen or fruit-growers in their execution of such laws. A resolution was passed expressing their appreciation of the efforts made by the entomologists and horticultural inspectors for their coöperation toward improving the insect pest legislation.

[1] August, 1908, I:270-73.

A resolution endorsing a national law providing for the government inspection of all imports was referred to their Legislative Committee.

The members of your committee present were given an opportunity to discuss national legislation for the inspection of imported nursery stock as well as nursery stock for interstate traffic in pursuance with the action taken by this Association. Every effort was made to come to some definite arrangement for future action. It was clearly seen at this meeting, however, that the sentiments of the nurserymen as a whole were not in favor of legislation of this character at this time, but that they still desired more uniformity in the inspection laws of the several states.

Respectfully submitted,

T. B. SYMONS,
A. F. BURGESS,
Committee.

On motion it was voted that the report be accepted and the committee discharged.

The report of a committee appointed to attend the Annual Meeting of the Society for the Promotion of Agricultural Science was presented by the Secretary, as follows:

REPORT ON AFFILIATION WITH AGRICULTURAL ORGANIZATIONS

Mr. President and Members of the Association:

Last August I received a letter from Prof. Thomas F. Hunt, director of the Pennsylvania Experiment Station and who was president of the Society for the Promotion of Agricultural Science, asking that a committee of this Association be appointed to attend a conference in Washington, D. C., in November, to consider the advisability of affiliating the different societies interested in agricultural science. The letter was transmitted to Dr. S. A. Forbes, the President of this Association, who appointed Dr. J. B. Smith, Prof. Franklin Sherman, Jr., and myself as members of that committee. Professor Sherman was unable to attend the meeting, but Doctor Smith and myself were present. Nothing definite was accomplished, as the Society for the Promotion of Agricultural Science had no definite plan to discuss. Some of those present were in favor of forming a national society for the advancement of agricultural science by using the Society for the Promotion of Agricultural Science as a basis. After the other societies interested in the matter had joined this association, it was planned to form sections.

Another idea was to have some simple form of affiliation so that meetings could be carried on during the general sessions without serious conflicts in the program.

Several days after this meeting I had the following correspondence with Dr. H. J. Wheeler:

KINGSTON, R. I., November 25, 1908.

MR. A. F. BURGESS,
Bureau of Entomology,
U. S. Dept. of Agr., Washington, D. C.

Dear Sir: As a member of committees representing two organizations which have under consideration the desirability of affiliating various scientific societies dealing with applied science in its relation to agriculture, I write to

say that it has been proposed that an attempt be made to secure a meeting of members of committees representing these various societies on the subject of affiliation in the near future. I should like to ask whether your committee from the Association of Economic Entomologists would be able to meet with the other committees at the close of the meetings of the American Chemical Society, the American Association for the Advancement of Science, etc., at Baltimore.

A copy of this letter is being sent to the three members of your committee.

If you have in mind any definite proposition covering a scheme of federation and involving a plan for having a common editor, with perhaps a separate body of associate editors for each branch, I should be glad to hear what you would propose.

In connection with the consideration of this matter, it would be well to take into account that we have a Society for the Promotion of Agricultural Science. It has been proposed that this be enlarged to embrace all of the various sciences and that the society then divide itself into sections corresponding closely with the American Association for the Advancement of Science, except that this organization would deal with applied science in its relation to agriculture.

It would also be well to take into consideration what disposal shall be made of the scientific work done in connection with the Adams fund in the various experiment stations.

Shall it be published in the separate organs of the several societies or in the separate organs of the joint society, or shall it be published, if possible, through the Office of Experiment Stations in Washington? Is it desirable in your opinion that there should be critical discussions of other work in connection with these papers whenever desired? In your opinion would this be possible or feasible if done in a dignified and proper way, provided the publication were done through the Office of Experiment Stations? If all of this work is to be published in the organs of such a joint society, how shall it be financed?

These are some of the important questions which you should have under consideration, and I should be glad to hear from you concerning any one or all of them, or any other points which may occur to you.

I hope that I may hear that your society will be represented at the Baltimore meeting, so that an arrangement for a joint meeting of all of the committees can be made to take place immediately upon the adjournment of the various sections that will meet at that time.

Very truly yours,

H. J. WHEELER.

WASHINGTON, D. C., November 28, 1908.

DR. H. J. WHEELER,
Kingston, R. I.

Dear Sir: Replying to your letter of the 25th inst., I will say that it would appear to me to be very desirable to hold a meeting of the committees representing the various societies at Baltimore. Personally it would be more convenient if the meeting was held on Wednesday, or at latest, on Thursday.

The annual meeting of this Association will be held on Monday and Tuesday and the matter will undoubtedly be discussed and some action taken along the line of instructing the committee as to the attitude that should be taken in the matter.

As you ask for my opinion about the proposed affiliation, I herewith submit a plan that I believe to be workable and one that will accomplish the main object in view. This is my personal view of the matter and should not be considered as expressing the sentiment of this Association.

The plan I have in mind is to affiliate the societies now existing for the advancement of agriculture. This should be done by having each society select one of its members, who should be given power to act for it, to represent the society on a joint board or council. This body should be the executive head of the affiliation and should organize by electing a president and a permanent secretary and such committees as are necessary to properly con-

duct special lines of work. The permanent secretary should be the most able scientific man that can be secured, regardless of whether he is a member of the council or not.

The council through its secretary or committees could make arrangements for meetings, have general supervision over the programs and matter for publication. In this way papers bearing on closely related subjects could be so arranged on the programs and the time of the meetings so provided for that greater benefit would be derived by the members who attend.

This arrangement would be quite simple and would preserve the identity of each society participating. I feel sure that some of the older societies which would favor a plan of this sort would strongly oppose or refuse to affiliate in a new society where they would simply become sections and their identity would be lost.

It seems to me that only papers dealing with agricultural problems of broad scope should be published in a central journal and that every endeavor should be made to have this issued by the Office of Experiment Stations or other office in the U. S. Department of Agriculture that is willing to do this work.

Other papers should be published as heretofore.

Trusting that these suggestions may be of some help to your committee and feeling sure that this Association will send a committee to represent it at the Baltimore meeting, I am

Yours very truly,
A. F. Burgess,
Secretary.

Nothing further has developed concerning the matter, but it is probable that a meeting will be held this week. It would be well for the Association to consider this matter and decide what action should be taken, so that if a committee is to attend a conference it can have some definite instructions.

President Forbes stated that this report was of an *ad interim* committeee which had been appointed as a courtesy to those interested in the matter, and that the whole proposition was now open for discussion.

Mr. Marlatt stated that he had not given the matter serious consideration, but felt that it was unwise to do anything that would affect the independence of this Association. He had observed that societies which go into a general organization and partially lose their identity are less vital than when they are independent organizations. He cited Section F of the American Association as an illustration of this condition, and suggested that the whole matter be laid upon the table.

Mr. Sanderson remarked that he agreed with what Mr. Marlatt had said in regard to losing the identity of this Association. He thought, however, that it might be an advantage to have all the agricultural associations of the country meet at the same place during one week. This meeting, if properly arranged, might be a distinct gain to agriculture in this country as well as to the associations themselves. He was in favor of having the committee continued or a committee appointed to investigate the matter.

Mr. Webster explained that he was a member of the executive

committee of the Society for the Promotion of Agricultural Science and felt that it was not the desire of the Society to have any of the agricultural societies lose their identity by participating in an affiliation. He stated that in the past, before the Entomological Society of America was formed, it was customary for all kinds of papers on entomology to be presented before this Association. Now papers relating more particularly to systematic work were presented before that society. It might be well for that society to continue to meet with the American Association for the Advancement of Science and it is possible that papers of a strictly economic character could be read before an association where botanists, chemists and other agricultural workers might secure some benefit. This would be broadening and beneficial to all economic workers.

Mr. Hopkins thought that the movement involved progressive ideas and that an affiliation which would not result in the surrender of the identity of this Association would be beneficial.

A member called attention to the fact that many would not be able to attend more than one meeting in a year and that this would mean that there would not be a large attendance if the Entomological Society of America and this Association met at different places. He was in favor of having a committee investigate the matter.

Mr. Marlatt stated that he had no desire to prevent progress in the matter, if progress is possible. He was still opposed to any loss of identity of the Association, as he considered this would be a poor policy.

A motion was made by Mr. Hopkins that a committee of three be appointed to confer with committees from other societies and report to the Association at the next meeting and that the committee now appointed present a general plan of action for the consideration of the Association before final adjournment.

After a brief discussion a vote was taken and the motion prevailed.

The President appointed the following committee: Lawrence Bruner, A. D. Hopkins and J. B. Smith.

Mr. Smith asked to be relieved from serving on the committee and A. F. Burgess was appointed in his place.

The Secretary called attention to the fact that several members had submitted titles of papers that had arrived too late to be included in the printed program.

By vote of the Association, the Secretary was instructed to interpolate these titles in the program.

Mr. Sanderson announced that arrangements had been made to have a photograph of the Association taken immediately before the opening of the afternoon session.

On motion a committee of five was appointed to draft suitable resolutions on the death of the members that had passed away since the last meeting.

The chair announced the following committees:

Membership—H. E. Summers, J. B. Smith and H. Garman.

Nominations—E. D. Sanderson, Franklin Sherman, Jr., and E. S. G. Titus.

Resolutions—E. P. Felt, F. L. Washburn and R. I. Smith.

Auditing—W. F. Fiske and W. E. Britton.

Memorial Resolutions—J. B. Smith, Henry Skinner, M. V. Slingerland, L. Bruner and R. A. Cooley.

The meeting then adjourned until 1 p. m.

The following report was submitted by the Committee on Nomenclature by Mr. Herbert Osborn:

REPORT OF THE COMMITTEE ON NOMENCLATURE

The committee believes that some general policy with reference to the use of common names applying to a number of species in a genus, and separate names for larvæ and adult stages in cases where both may be commonly known as destructive forms may be necessary, and hopes to present some recommendations by another year.

We recommend the incorporation of the names approved at this meeting in the list hitherto adopted and the publication of the complete list in the proceedings of the society, with distribution as heretofore to agricultural journals and entomological writers.

The committee desires to thank the many members who have interested themselves in this matter and have assisted by suggestions, and it is hoped that this assistance will be freely continued.

Respectfully submitted,

HERBERT OSBORN,
E. S. G. TITUS,
A. L. QUAINTANCE,
Committee.

By vote of the Association the report was accepted and the list which follows was adopted.

LIST OF COMMON NAMES ADOPTED

Alfalfa leaf-weevil	*Phytonomus murinus* Fab.
Angular-winged katydid	*Microcentrum retinerve* Burm.
Apple leaf-hopper	*Empoasca mali* LeB.
Apple leaf trumpet miner	*Tischeria malifoliella* Clem.
Apple twig-beetle	*Stephanoderus hispidulus* Lec.
Barnacle wax-scale	*Ceroplastes cirripediformis* Comst.
Bean leaf-beetle	*Ceratoma trifurcata* Forst.
Bean leaf-roller	*Eudamus proteus* Linn.
Beet leaf-hopper	*Eutettix tenella* Bak.
Blackhead cranberry worm	*Eudemis vacciniana* Pack.

Black peach aphis	*Aphis persicæ-niger* Er. Sm.
Cabbage webworm	*Hellula undalis* Fab.
Cactus scale	*Diaspis echinocacti* (Bouche).
Chain spotted geometer	*Cingilia catenaria* Drury.
Cherry aphis	*Myzus cerasi* Linn.
Cherry fruit maggot	*Rhagoletis cingulata* Loew.
Cigar case-bearer	*Coleophora fletcherella* Fernald.
Citrus rust mite	*Eriophyes oleivorus* Ashm.
Citrus white-fly	*Aleurodes citri*, R. & H.
Clover seed chalcid fly	*Bruchophagus funebris* How.
Cowpea weevil	*Bruchus chinensis* Linn.
Cranberry fruit-worm	*Mineola vaccinii* Riley.
Currant aphis	*Myzus ribis* Linn.
Currant fruit-fly	*Epochra canadensis* Loew.
Eight-spotted forester	*Alypia octomaculata* Fab.
Euonymus scale	*Chionaspis euonymi* Comst.
European elm scale	*Gossyparia spuria* Modeer.
European fruit-scale	*Aspidiotus ostreæformis* Curt.
European grain aphis	*Siphocoryne avenæ* Fab.
Eye-spotted bud-moth	*Tmetocera ocellana* Shiff.
Fern scale	*Hemichionaspis aspidistræ* (Sign).
Flat-headed apple-tree borer	*Chrysobothris femorata* Fab.
Florida red scale	*Chrysomphalus ficus* Ashm. (*aonidum*).
Florida wax-scale	*Ceroplastes floridensis* Comst.
Fuller's rose-beetle	*Aramigus fulleri* Horn.
Gloomy scale	*Chrysomphalus tenebricosus* (Comst).
Glover's scale	*Lepidosaphes gloveri* Pack.
Gooseberry fruit-worm	*Zophodia grossulariæ* Pack.
Grape berry moth	*Polychrosis viteana* Clem.
Grape curculio	*Craponius inæqualis* Say.
Grape leaf-hopper	*Typhlocyba comes* Say.
Grape plume moth	*Oxyptilus periscelidactylus* Fitch.
Grape root-borer	*Memythrus polistiformis* Harr.
Grape root-worm	*Fidia viticida* Walsh.
Grape sawfly	*Blennocampa pygmaea* Say.
Grape scale	*Aspidiotus uvæ* Comst.
Grapevine aphis	*Siphonophora viticola* Thos.
Greedy scale	*Aspidiotus rapax* Comst. (*camelliæ*)
Greenhouse white-fly	*Aleurodes vaporariorum* West.
Green June beetle	*Allorhina nitida* Linn.
Hemispherical scale	*Saissetia hemisphærica* Targ.
Howard's scale	*Aspidiotus howardi* Ckll.
Imported cabbage worm	*Pontia rapæ* Sch.
Imported currant worm	*Pteronus ribesii* Scop.
Io moth	*Automeris io* Fab.
Lesser apple worm	*Enarmonia prunivora* Walsh.
Lime-tree winter moth	*Erannis tiliaria* Harr.
Lubber grasshopper	*Brachystola magna* Gir.
Magnolia scale	*Neolecanium cornuparvum* Thro.
Negro bug	*Corimalæna pulicaria* Germ.

Orange dog	*Papilio thoas* Linn.
Orange maggot	*Trypeta ludens* Loew.
Oriental moth	*Cnidocampa flavescens* Walk.
Peach bark-beetle	*Phloeophthorus liminaris* Harris.
Peach twig-moth	*Anarsia lineatella* Zell.
Pear-leaf blister-mite	*Eriophyes pyri* Pagnst.
Pear thrips	*Euthrips pyri* Daniel.
Potato-tuber worm	*Phthorimæa operculella* Zeller.
Purple scale	*Lepidosaphes beckii* Newm.
Quince curculio	*Conotrachelus cratægi* Walsh.
Raspberry cane-borer	*Oberea bimaculata* Oliv.
Raspberry root-borer	*Bembecia marginata* Harr.
Red-humped apple caterpillar	*Schizura concinna* S. & A.
Round-headed apple-tree borer	*Saperda candida* Fab.
Sinuate pear-tree borer	*Agrilus sinuatus* Oliv.
Snowy tree cricket	*Oecanthus niveus* DeG.
Soft scale	*Coccus hesperidum* Linn.
Southern cabbage worm	*Pontia protodice* Boisd.
Squash lady beetle	*Epilachna borealis* Fab.
Strawberry crown moth	*Aegeria rutilans* Hy Edw.
Striped cucumber beetle	*Diabrotica vittata* Fab.
Sugar-cane beetle	*Ligyrus rugiceps* Lec.
Tent caterpillar	*Malacosoma americana* Fab.
Terrapin scale	*Eulecanium nigrofasciatum* Perg.
Tobacco flea-beetle	*Epitrix parvula* Fab.
Two-striped walking stick	*Anisomorpha buprestoides* Stahl.
Walnut scale	*Aspidiotus juglans-regiæ* Comst.
Woolly apple aphis	*Schizoneura lanigera* Hausm.
Yellow-head cranberry worm	*Acleris minuta* Rob.

Mr. Hopkins presented a list of common names of beetles, which he stated he had recently used in connection with a publication that had just gone to press and stated that he would like to present the list to the Association for adoption if there was no objection.

Mr. Sanderson stated that he had no objection to the names, but thought that they should be referred to the committee.

By vote of the Association the list was referred to the Committee on Nomenclature, with instructions to report on the matter before the close of the meeting.

The President called the attention of the Association to the fact that there was a vacancy on the Council, owing to the death of Dr. James Fletcher.

It was voted to elect one member to fill this position and Mr. Herbert Osborn was chosen to fill the unexpired term.

At the afternoon session Tuesday the following report was presented by the Committee on Insecticides, by Mr. E. D. Sanderson:

REPORT OF THE COMMITTEE ON INSECTICIDES

Your committee has had requests from several manufacturers for testing new insecticides, mostly scale remedies, most of which seem to have had no practical tests in the orchard. After consideration of the merits of those submitted, your committee deemed it best to adopt the policy of advising manufacturers that after they had made practical tests of their remedies in the field and furnished the committee with statements of the results, we would then investigate the results secured, and if the insecticides then seemed to have sufficient promise that we would then try and arrange coöperative tests. Manufacturers have been so advised and as yet no new insecticides have arisen which seem to your committee to need coöperative testing.

Your committee wishes to reaffirm the report of previous committees that a general testing of proprietary insecticides by individual entomologists is an unnecessary duplication of effort and that requests from manufacturers for such tests be referred to the committee for action. We would also urge that any new insecticides whose promise seems to warrant further testing be suggested to the committee by members of the Association so that coöperative testing may be arranged.

Your committee found that an amendment to the Pure Food and Drug Law to cover insecticides and fungicides was impractical and was instrumental in having introduced Senate Bill 6515 and H. R. Bill 21318, providing for the inspection of insecticides and fungicides by the federal government. A conference with the manufacturers was held in New York on June 16 and various amendments were proposed and the measure as amended was endorsed. An executive committee composed of two manufacturers, two entomologists, and one agricultural chemist was appointed, who have collected funds to provide for pushing the measure and are doing everything possible to organize the support of this measure before Congress. Your committee finds that this measure has the hearty support of manufacturers and consumers and urges its support upon the members of this Association.

Respectfully submitted,

E. D. Sanderson,
E. P. Felt,
H. E. Summers,
R. I. Smith,
Committee.

In discussing this report Mr. Slingerland asked if it was advisable to turn new insecticides back to the manufacturers to be tested by them.

In reply Mr. Sanderson stated that some new insecticides had been referred to the committee with a request that they be tested. It seemed a waste of time to test these materials unless it was known whether they were of some value. The better plan seemed to be to have the manufacturer place such insecticides in the hands of some

practical fruit grower for test, in order to ascertain whether they had any merit, before asking the entomologists to devote a large amount of time to testing materials, many of which would prove worthless.

Mr. Slingerland stated that he thought this was the right method to follow and that he knew of one case where a manufacturer was having an insecticide tested, at the expense of the company, before putting it on sale.

By vote of the Association the report was accepted and the recommendations adopted.

The Committee on Nomenclature presented the following report concerning the list of common names of insects submitted by Mr. Hopkins:

SPECIAL REPORT OF THE COMMITTEE ON NOMENCLATURE

Concerning the list of names submitted by Professor Hopkins your committee would recommend that the author's use of the names be commended and that their use by our members be advised, but that considering the fact that they have not been open to examination by the society or discussion by the commitee, their final adoption and incorporation in the list approved for universal use be deferred.

Respectfully submitted,
HERBERT OSBORN,
E. G. TITUS,
A. L. QUAINTANCE,
Committee.

On motion the report was adopted as read.

The Auditing Committee presented the following report:

REPORT OF THE AUDITING COMMITTEE

We have examined the financial accounts of the Secretary and find them correct.

W. F. FISKE,
W. E. BRITTON.

By vote of the Association the report was accepted.

The report of the Committee on Membership was next presented, by Mr. H. E. Summers.

REPORT OF THE COMMITTEE ON MEMBERSHIP

The committee has followed the policy of being rather strict in the interpretation of the rule regarding the admission of active members, and, on the other hand, of being as liberal as the rules seemed to allow in admitting to associate membership, with the idea of encouraging those who certainly have the intention of pursuing economic entomology as a profession, practically the only requirement for associate membership being that the candidate be vouched for by two active members and that he be occupying some

position in economic entomology. For two years past, the committee has failed to look over in advance of the meeting the list of associate members with any care to decide upon those that should be raised to active membership, the rule requiring that the committee should do this. The list presented this year, therefore, is especially long. It is a difficult thing, in many cases, to find out exactly the comparative merits in a long list that needs to be examined, and injustice may result in some instances.

The following recommendations are herewith submitted:

For foreign members:

Prof. Carlos E. Porter, Directeur de la "*Revista Chilena de Historia Natural*," Casilla 2352, Santiago, Chile.

Mr. Charles S. Reed, official entomologist, Mendoza, Argentine Republic.

For active member:

Dr. W. M. Wheeler, Bussey Institution, Forest Hills, Boston, Mass.

For transfer from associate to active membership:

C. N. Ainslie, Washington, D. C.
Fred E. Brooks, Morgantown, W. Va.
E. C. Cotton, Knoxville, Tenn.
John A. Grossbeck, New Brunswick, N. J.
T. J. Headlee, Manhattan, Kansas.
Glen W. Herrick, College Station, Texas.
G. W. Kirkaldy, Honolulu, H. T.
A. C. Morgan, Washington, D. C.
Dudley Moulton, Washington, D. C.
Edith M. Patch, Orono, Me.
W. A. Riley, Ithaca, N. Y.
A. G. Ruggles, St. Anthony Park, Minn.
C. H. T. Townsend, Washington, D. C.
R. L. Webster, Ames, Iowa.
R. S. Woglum, Washington, D. C.
E. L. Worsham, Atlanta, Ga.

For associate members:

George G. Ainslie, Clemson College, S. C.
W. W. Chase, Atlanta, Ga.
C. R. Crosby, Ithaca, N. Y.
D. T. Fullaway, Honolulu, H. T.
A. G. Hammar, Washington, D. C.
Paul Hayhurst, Bussey Institution, Forest Hills, Boston, Mass.
C. E. Hood, Dallas, Texas.
C. W. Hooker, Amherst, Mass.
J. R. Horton, Logan, Utah.
J. A. Hyslop, Washington, D. C.
E. L. Jenne, Washington, D. C.
A. H. Jennings, Ancon, Canal Zone, Panama.
E. O. G. Kelly, Washington, D. C.
Frederick Knab, Washington, D. C.
E. J. Kraus, Washington, D. C.
A. C. Lewis, Atlanta, Ga.

W. R. McConnell, State College, Pa.
A. H. McCray, Columbus, Ohio.
L. M. Peairs, College Park, Md.
C. H. Popenoe, Washington, D. C.
W. J. Price, Jr., Blacksburg, Va.
W. V. Reed, Atlanta, Ga.
D. M. Rogers, Boston, Mass.
A. F. Satterthwait, Harrisburg, Pa.
G. D. Shafer, East Lansing, Mich.
N. E. Shaw, Columbus, Ohio.
C. P. Smith, Logan, Utah.
L. M. Smith, Carbondale, Ill.
A. E. Stene, Kingston, R. I.
J. C. Stiles, Blacksburg, Va.
F. W. Terry, Honolulu, H. T.
W. F. Turner, Auburn, Ala.
T. D. Urbahns, Washington, D. C.
H. F. Wilson, Washington, D. C.
H. P. Wood, Dallas, Texas.
M. A. Yothers, East Lansing, Mich.

Respectfully submitted,
H. E. Summers,
J. B. Smith,
H. Garman,
Committee.

On motion the report of the committee was accepted and the recommendations adopted by the Association.

REPORT OF THE COMMITTEE ON MEMORIAL RESOLUTIONS.

The Committee on Memorial Resolutions submitted the following report:

Whereas, since the last meeting of this Association death has removed from our midst,

Dr. William H. Ashmead,
Mr. Alexander Craw,
Dr. James Fletcher,
Prof. Willis G. Johnson, and
Prof. Francis H. Snow, and

Whereas, in these deaths this Association has lost valuable members and we, their associates, have lost friends and fellow-workers, it is eminently fitting that we place upon our records an expression of our appreciation of the individual regard for the scientific man and of sorrow for the loss.

Dr. William H. Ashmead was long, if not very closely, associated with us and was one of the pioneers in economic entomology in the South, and though in later years better known as a systematist, he always retained an interest in our meetings and purposes. His work among the parasitic Hymenoptera was of the utmost importance to the practical worker, and of high scientific value: he was indefatigable as a student and there is no doubt that his devotion to his work shortened his days. As a man, the best that can be said of him is that he was a gentleman: courteous always, frank, obliging, and scrupulously exact in his dealings with his fellows. His death is a loss to Entomology from all points of view.

Alexander Craw was associated with us for many years, but more in spirit and purpose than in bodily presence. He carried on a most important economic work on the Pacific coast and California fruit growers, especially, owe him a debt of gratitude for the entomological work done by him. He was the first quarantine officer for insect inspection work and his efforts to keep out injurious species were untiring and markedly successful. Persistent and painstaking in all his undertakings he gained the confidence and respect of the community in which he worked, and did much to further economic entomology.

Dr. James Fletcher was one of the men whose efforts dignified work in economic entomology when such work was little regarded and less appreciated. He was one of those who was active in organizing this Association and worked tirelessly to secure its success: he thoroughly believed in the value and usefulness of our work, and by his persuasive speech and personal magnetism he impressed his conviction upon others and secured results that no one less energetic than he could have obtained: he made friends of his constituents and made them believe in him, being careful at all times to justify their belief: he was a friend and helper to all who were interested in natural history and was active in societies and other organizations dealing with such and related subjects: no one ever applied to him in vain for anything that he could give and the amateur or student was always sure of assistance for the asking: his jolly, good-natured presence was always an incentive to better work and no meeting was dull when he joined in the discussions; although his work was in Canada ranging from the Atlantic to the Pacific, he visited all parts of the United States, had a personal acquaintance with most of our members and was a contributor at nearly all our meetings.

In his scientific attainments he was broad and varied, his entomo-

logical work forming only a part of his interests; but economic entomology is especially indebted to him for its advancement, and economic entomologists owe him a debt of gratitude, the extent of which is as yet hardly realized.

Prof. WILLIS G. JOHNSON was a younger man, cut down in his prime, full of life and vigor, radiating vital energy, always enthusiastic and earnest in all his undertakings. His training was of the modern type and he was one of the first of the younger men to enter work in economic entomology, well equipped by teachers and by service under veterans in our science. He was also one of the first to inaugurate a vigorous campaign in the Atlantic Coast states against the San José scale, and his work in Maryland opened up original methods and impressed upon the community the necessity for concerted action. Legislation against injurious insects and control by inspection and fumigation in the East found one of its earliest and most persistent advocates in Professor Johnson and his work has served as a guide to those who followed him. For some years before his death he abandoned his work in entomology for service on a farm paper, but in this position he also did much educational work in economic entomology and always maintained his interest in our association.

Prof. FRANCIS H. SNOW, of Kansas, was an example of a long life well spent in service to the community. Modest and unassuming in manner, always quiet in his methods of work, he exercised an influence that was mighty in extent. As an educator he is affectionately remembered by several of our members, and his work for our science in the training of students is one that cannot be too highly estimated. But not only as a teacher is he to be remembered: he was an original investigator and thinker as well, and to him economic entomology owes much for his researches and practical experiments with certain diseases of insects. The institution with which he was so many years connected owes much of its development and influence to him, especially the enormous collections made on his annual trips for the last twenty years, and while he was never active in the affairs of this Association he was a member of whom we were justly proud, and whose name added to the dignity of our body.

Now, therefore, be it

Resolved, That this Association as such and its members, individually, do hereby express profound sorrow for the loss of these, our fellow-members, and appreciation for their attainments.

Resolved, further. That this minute be spread upon the records of the society and published as a part of its proceedings.

Respectfully submitted,

JOHN B. SMITH,
HENRY SKINNER,
M. V. SLINGERLAND,
LAWRENCE BRUNER,
R. A. COOLEY,
Committee.

By vote of the Association the resolutions were adopted as read.

The report of the Committee on Resolutions was presented as follows:

REPORT OF THE COMMITTEE ON RESOLUTIONS

Resolved, That the Association of Economic Entomologists hereby expresses its appreciation for the courtesies extended by the local committee on arrangements and by the Board of Education of Baltimore.

Resolved, That as an Association we urge upon Congress the importance of passing House Bill No. 21318 and Senate Bill No. 6515, which provides for regulating the standards of insecticides and fungicides entering into interstate commerce.

Resolved, That we again place on record our conviction that the control of the gypsy moth in New England is an entomological problem of the first magnitude and of great practical importance to the entire country. Furthermore, we would emphasize the necessity of the State of Massachusetts continuing with undiminished vigor the policy prosecuted so ably during the past few years.

Resolved, That this Association emphasizes most strongly the importance of insects as carriers of disease, and hereby urges its members to do all in their power to better sanitary conditions.

Resolved, That the members of this Association hereby express their thanks to A. F. Burgess for his most efficient services as Secretary during the past four years.

Respectfully submitted,

E. P. FELT,
F. L. WASHBURN,
R. I. SMITH,
Commitee.

The following amendment presented by Messrs. Washburn and Smith of the committee was added, and by vote of the Association the report was accepted as amended.

Resolved, That this Association in congratulating itself on the success of the JOURNAL OF ECONOMIC ENTOMOLOGY during the past year, hereby testifies its appreciation of the work of the Journal's Board of Editors, through whose generous efforts the success of this, its first year, has been secured.

The report of the Committee on Affiliation was presented by Mr. Hopkins, as follows:

REPORT OF THE COMMITTEE ON AFFILIATION

After considering the matter of affiliation of the different societies interested in agriculture, the committee believes that the statement which follows will serve as a basis for discussing the matter if it seems desirable to have any affiliation.

Condition

There are many societies with widely varying fields of usefulness having for their common object the general advancement of agriculture, but with at present no organized effort towards common efficiency, consequently, there is much duplication of effort, discussion, expenditures, etc.

Needs

There is special need for some form of affiliation, by which the identity of each society may be retained for its special objects, but by which the common interests and objects of all will be furthered.

Plan of Organization

Name: The Affiliated Societies for the Advancement of Agriculture.

Object: To contribute to the advancement of agriculture by promoting the common objects and interests of all scientific and other societies organized for the consideration of subjects relating to agricultural science.

Plan of Affiliation: One elected representative of each society to constitute a council for the consideration of all subjects of common interest. The council to serve as an executive head of the affiliation, with its president, permanent secretary and committees on meetings, programs and publications.

The permanent secretary should be the best man available regardless of membership on the council.

Lawrence Bruner,
A. D. Hopkins,
A. F. Burgess,
Committee.

By vote of the Association, the recommendations were adopted, and the Committee was instructed to insist upon the principles outlined when meeting with the other committees appointed to consider affiliation.

REPORT OF THE COMMITTEE ON NOMINATIONS

The report of the committee was submitted as follows:

For President, W. E. Britton, New Haven, Conn.

For First Vice-President, E. D. Ball, Logan, Utah.

For Second Vice-President, H. E. Summers, Ames, Iowa.

For Secretary, A. F. Burgess, Washington, D. C.

For Member of Committee on Nomenclature, Herbert Osborn, Columbus, Ohio.

For Member of Advisory Board of Journal, one year, Wilmon Newell, Baton Rouge, La.

For Members of Advisory Board, three years, H. T. Fernald, Amherst, Mass.; Herbert Osborn, Columbus, Ohio.

For Members of Council, S. A. Forbes, Urbana, Ill.; H. E. Summers, Ames, Iowa.

Respectfully submitted,
E. D. SANDERSON,
FRANKLIN SHERMAN, JR.,
E. S. G. TITUS,
Committee.

By vote of the Association, the Secretary was instructed to cast a ballot for the officers recommended by the Committee, and they were declared duly elected.

Mr. Sanderson called attention of the Association to the large amount of work which now devolves upon the Secretary, and stated that he thought that the expenses incurred by the Secretary in attending the annual meeting should be paid.

Mr. Britton stated that while he was heartily in favor of paying the Secretary, he believed it would be much better to pay a stated salary than to pay his expenses when attending the annual meeting.

By vote of the Association the matter of compensation of the Secretary was referred to the Executive Committee for report at the next annual meeting.

It was voted that the time and place of the next meeting be decided by the Executive Committee.

There being no further business the meeting adjourned.

PART II

The address of the President was presented at the opening session on Monday morning, as follows:

ASPECTS OF PROGRESS IN ECONOMIC ENTOMOLOGY

By S. A. FORBES, *Urbana, Ill.*

It is fifteen years since I had the honor and the privilege of presiding over the Fifth Annual Meeting of this Association at Madison, Wisconsin, and of presenting to it the annual address, and my thoughts naturally revert to the conditions of that time as a means of measuring the progress we have made. We have met some very heavy losses since 1893, in Riley, the prince of economic entomologists, and one of the great founders of our science; in Lintner, a careful, thor-

ough student, a clear, methodical writer, a correct and genial gentleman; and now in Fletcher, whose late departure has made of this society a family of mourners, each of us grieving as over a personal loss. Many others have left our little group in these fifteen years, either by the road which we all at last must travel, or drawn away from the difficult and perplexing path of economic entomology into others more inviting to them.

But serious as our loss has been, our gains, I need hardly say, have far surpassed them. I referred, I remember, in the address I have mentioned, to the time then passing as the classic period in economic entomology—the time of the beginnings of great things, when the larger features of our field were just becoming fairly outlined, when the essential methods of our work were being definitely agreed upon and brought into general use. The older method of observation, description and deductive inference—the method of Harris and Fitch and Walsh and Le Baron, and of Riley in his younger days—was yielding to the method of comprehensive survey, exact experiment, and practical verification in the field, which characterizes all our best recent work; and among the older men—self-taught entomologists most of us—were appearing a younger generation of well-trained scientists, taught, in many cases, it is true, by teachers who had themselves had no specialized training, but who taught well and thoroughly nevertheless because they were born to teach, and who had been, consequently, their own first and best-taught pupils. And now this younger generation of well-trained students, whose presence at Madison was welcomed with hopeful anticipation, is itself beginning to get a little gray at the temples and a little bald under the crown of the hat, and the country is alive with bachelors and masters of science and doctors of philosophy, a small army of whom are at work each in his special part of our general field.

Besides this great and surprising increase in the number of workers on our subject, and this very great improvement in their scientific preparation for their work, none of us who are fifteen entomological years of age can have failed to note an equally great and encouraging improvement in our methods of investigation, in our means and forms of publication, and in ways of bringing our results promptly to practical application by those in whose interest all our studies are made. Our work has become at the same time more scientific and more practical, better based in scientific principles of permanent character and wide application, and better worked out in ways to commend its results immediately to our economic constituency.

Trusting, however, to your recollection of your own observations

and experience for a sufficient review of these matters of recent history, I would like to use my present brief and rare opportunity and privilege in an endeavor to forecast the immediate future, and, judging from what we have seen and what we now see in progress, to deduce the probable next steps in the development of method in our work.

Economic entomology is an extremely complex subject, not only by reason of the number of factors which it must include, but especially because of the variability of many of these factors, and our inability to predict the course of events with certainty in our field. We study the present and the past in a practical way in order that we may predict the future. We observe, generalize, experiment and verify in order that we may be able to say to the farmer or the fruit grower, "Do thus and so in any given case, and this or that desired result will follow;" but we can rarely express our conclusions safely in so definite a form. Often the best we can fairly say is that if the weather should be wet, or dry, or neither one nor the other, as the case may be; or if it has been very wet, or very dry, for the last two or three or four years; or if the winter has been, or is to be, open or severe; if the crop in question has been preceded by some other kind of crop, or by one of the same kind; and if the insect situation was thus and so last year and the year before; if, furthermore, the land is light or heavy, high or low, well drained or wet; if it has had this or the other management or treatment during the last year or two; and if several other variable elements of the problem vary to such or such a degree, in this or the other direction—then if the operation X be performed, the result will *probably* be Y, but with what *degree* of probability it is impossible for us to say. Agriculture is itself one of the more uncertain callings, and the farmer every year bets the cost of his crop on the chances of his harvest; but the entomology of agriculture is more uncertain still, for insects liable to infest a crop are affected, directly or indirectly, obversely or inversely, by everything which affects the crop itself, and by several other things beside. How may we approximate certainty of prediction in this variable tangle of uncertainties within uncertainties in the midst of which we have to work? It is only by long-continued observation, by comprehensive survey of all related matters, by repeated and varied experiment, and by the use of *statistical methods* such as will teach us the range of variation and the character of the average in any given case. By an intelligent use of counts and estimates and averages we can often approximate certainty, where without them our uncertainty would be complete. We can say that in about such a per cent of so many trials you will get your desired

result, where otherwise we ought really to say nothing at all; and the statistical method of record and report has always the great advantage that it conveys perfectly definite information, and that it gives us a structure of fact to which the next man may safely build. It enables us to accumulate results by adding one like unit of construction to another, whereas otherwise each little structure must stand by itself for what it appears to be worth. I confidently expect to see this aid to accurate work more and more used in coming years, until a paper whose data of observation and experiment are not summed up in statistical tables or their equivalent will be as rare as the old-style paper of deductive inference to economic measures is today.

Next to the command and use of this method of statistics—a completed method ready-made to our hands, and which we have only to appropriate and adapt to our ends—I have come to look, of recent years, with eager interest to the new and still developing *methods of ecology* as an aid to our work on our larger and more difficult problems. Economic entomology is, in fact, a special division of ecology. It has to do with the relations of insects to the welfare of man. It is the science of the interactions, direct and indirect, between man on the one hand and insects on the other, in so far as these interactions affect human welfare. The welfare of man is the primary study, and entomology comes into the field only in a secondary way. Now the ecologist studies, analyzes, classifies, generalizes and interprets the relations of interaction between all organisms and their entire environment, inorganic and organic. On the side of the environment he studies all features and factors which in any way condition or affect the life of animals and plants; on the side of the organism he studies all the reactions, adaptations and immediate or final effects which are in any way traceable to the factors of the environment; and on both sides of the relation he seeks for causes, for principles, for laws, which are permanent and invariable because they are involved in the nature of things—in the nature of protoplasm on the one hand, and in that of the physical world on the other.

So regarded and so studied, ecology evidently lies at the very center of biology. Indeed, it is practically identical with biology as defined, perhaps most clearly, by that great zoölogist—that great naturalist—Brooks, of Johns Hopkins, who says in the introduction to his remarkable volume on "The Foundations of Zoölogy," that life is response to the order of nature, that biology is the study of this response—of this reaction; and that the study of the order of nature to which response is made is as well within the province of biology as a study of the living organism which responds. Upon this topic of en-

tomological response—of ecological interaction—we economic entomologists have been busy all our working lives, whether we have made precise note of the fact or not. We are indeed, whether we have meant to be or not, the leading ecologists in America today. As practical entomologists, however, our work has run, as a rule, along too narrow lines to give us an adequate view and command of the whole field; and there is now coming to our aid a group of active young ecologists who, unfettered by any responsibility for an economic result, are working out the relations of organisms to peculiarities of local situation and condition, who are searching for the causes of local distribution and abundance in the facts of interaction and adaptation, and who are tracing also the history and development of this distribution and association of species by processes as careful and as promising of fruitful result as those which have given us the geological history of the globe. All of their most general, most important results must apply in our special field; and a knowledge and appreciation of their method will lead us to study our larger problems in the large way; to treat an entomological inquiry as merely a special item in a broad investigation, which shall include, from the beginning, all the factors which can enter into it or influence it to any significant degree. It is particularly important to us that we should have clear ideas of the system of relations existing in our several districts between insects and the *organic* world at large, before civilized man appeared upon the scene, with his associate group of intrusive animals and plants; for we can only modify or disturb, often to our own disadvantage, this primitive natural order, and can never wholly replace it. The same forces which established it in the beginning are constantly at work, not perhaps to reëstablish the old order, but at least to rectify disturbances due to us and to establish finally a new order of equilibrium between the remaining remnants of the old and the intrusive elements we have introduced.

Permit me to give you a simple illustration of the application of the ecological method to the organization and discussion of the data of an economic problem; and for this purpose I will take the corn-insect problem as the one with which I am, perhaps, most familiar. From the ecological point of view a corn field is a situation—a habitat, a biotope—and its inhabitants are a biological association, or a biocœnose. The assemblage of plants and animals characteristic of it is found together in the corn field because of its special fitness for their occurrence and their maintenance there, and this assemblage has had its history of first appearance and gradual transformation. It has its important relations to surrounding situations, and to their charac-

teristic associations of plants and animals—those of the pasture, the oats field, and the like—and its relations also to associations preceding it on its own area. As a biological association the inhabitants of the corn field are variously related to each other—as competitors, as enemies, as parasites, as coöperating partners, or as mere indifferent companions, and their varying actions and interactions make up the general ecological system of this corn field situation. The leading members of this association, the kinds of organisms which may almost invariably be found together in it, are certain grasses—species of *Setaria* and *Panicum* especially; and certain smartweeds or heartweeds—species of *Polygonum*—all of which start spontaneously from the seed in very early spring; the corn plant itself—whose dominance gives its name to the association, the corn-field ant (*Lasius niger americanus*), the corn root-aphis, the corn root-worm, the white-grubs, and the ear-worm; and to these we must add two other members of the group, without which there could have been no cornfield in the beginning, and none could continue so much as a single year—that is, the horse and the man. The man, the horse, the corn plant, the smartweed, the two grasses mentioned, the ants, the aphids, the grubs, and the ear-worm are the essential members of this association; but with these, I need not say, we must often include many other occasional or less conspicuous members—the wireworms and the bill-bugs, if a pasture or meadow has preceded corn within a year or two; the cutworms and the army-worm, perhaps, in spring, and the grasshoppers in fall, if such an association is established beside it; many species of birds, most of which are, as a rule, scarcely more than accidental visitants; the moles, the ground-squirrels, and the mice, which have their more or less definite reasons for frequenting it or for residing in it.

If we analyze the relations of these various inhabitants of the field we find that three of these kinds form a coöperating partnership and that two of them form another—the man, the horse and the corn plant in one such group and the corn root-aphis and the cornfield ant in the other. The interests of the former group are in open opposition to those of all the other inhabitants of the field, so much so that this group would profit greatly by the extermination of all the rest; and its dominant agent, man, being more or less aware of this fact, he seeks, as a rule, to destroy them all as completely as he can. He fails to do so completely, notwithstanding his best endeavors, because some of his competing associates are really better adapted to the situation than the corn, the horse, and the man themselves; and, furthermore, because several of the competitors of this dominant group thrive most by the very measures which it takes in its own immediate interest. The ear-

worm would be compelled to seek its food in other and much less abundant plants, the corn root-aphis would be limited to the comparatively sapless roots of the small field weeds; the cornfield ant would have to forage mainly for its food, and the corn root-worm would seemingly perish from off our area if it were not for the contributions to their welfare made by man in the pursuit of his own ends.

Similar incidental contributions of one group to the welfare of another are seen in the relations of the weeds of the field in early spring to the first seasonal appearance of the corn root-aphis, which is dependent for its maintenance on these young weeds for as much as a month before the corn has begun to grow. This seasonal succession of plants in the cornfield is thus a necessary condition to the existence of the aphis there. On the other hand the corn root-worm could not exist except for the continuance of corn in the same situation as a member of the associate group year after year; and the corn itself would fall a speedy victim to its enemies and competitors if it were not regularly relieved from the consequences of its own incapacities and its failures of adaptation by the interested aid of man. We have so cherished and protected this plant for untold generations that it is permanently fixed in a state of infantile helplessness, incapable of independent competition with the other plants of its association, and about as defenseless against insect attack as is a flock of sheep against a pack of wolves. By the constant interference of our planting and our cultivating processes, and by our selection of characters which adapt the plant to our needs, to the neglect of those which might make it independent of our care, we have wholly prevented all spontaneous adaptation of the corn plant to the conditions of its own maintenance, and it has hence made no progress towards independent life during all the centuries or millenniums of its residence in our territory.

I have wondered if, in this respect, we might not improve our selection by sometimes giving the preference, in saving seed, to those plants which have best withstood unfavorable conditions, instead of making our choice, as we now invariably do where we choose at all, from among the plants which have succeeded best where all the conditions have been favorable. I would like to see the experiment made of growing corn from seed taken from the few best stalks of a field which has been overrun by insects, in the hope that we might thus gradually develop varieties of this plant capable of withstanding insect attack, or of selecting our seed from the best grown and most fruitful plants in a field which has suffered heavily from drouth—of applying, in short, the method by which rust-resistant varieties of wheat and the like are now being formed.

This imperfect sketch and discussion of the cornfield situation may serve to illustrate the value of the ecological view in compelling a comprehensive survey of the general field in which an entomological problem is involved, and a careful mustering and orderly assembling of its whole content, insuring us against the overlooking of any significant factor or the overweighting of any minor element. Whether we use the terms of ecological discussion or not, we treat our subject imperfectly if we do not use its methods and draw our data from its whole domain.

To these general suggestions, looking towards the development of our methods of investigation, I will only add a point or two pertaining to the other side of our relationship. If entomology were the sole subject of our study, we might be satisfied with our progress if we were merely contributing to the sum of available knowledge on that subject; but if it is our special task to aid in the general work of improving the conditions of life for our people, then we can only rest satisfied when we see that the conditions of their life have actually been improved. I sometimes think that only the simpler and easier part of our work has been done when we have *discovered* the truth, and that the task of making it to prevail in the practice of life is much the more arduous and difficult. Until we, or some one else for us, can hitch fact to practice, we are as helpless to move towards our main end as is a teamster with a loaded wagon who has no harness for his team.

A general practical use of our material results is, moreover, the indispensable verification of them, preceding which they are economic hypotheses only; and we can no more stop short of this final test than the physicist can omit the verification process in his experimental studies. Anything which will help us to bring to bear on our conclusions this test of average use under the ordinary conditions of economic operation must be most welcome to us, and I hope that we may get the light of each other's experience and the help of each other's suggestions on this most difficult part of our duty. I have lately found great advantage in the establishment, in relation to the work of my office, of an advisory committee, consisting, in this case, of the director of the agricultural experiment station of the state, and of two representatives of the State Horticultural Society appointed by its president, and two representatives of the State Farmers' Institute. This committee, meeting at the call of the entomologist and in consultation with him, takes his plans under consideration and approves, amends or rejects them, according to their judgment, after full statement and discussion. The law by which it is constituted, passed at

my request, provides that the appropriations of the office shall be expended on lines approved by this committee.

I have thus in frequent consultation with me a group of thoroughly representative, public-spirited men, personally or professionally interested in the various lines of our horticultural and agricultural work, who know of and believe in our undertakings and are in a position to test our results themselves in a practical way, and to influence others to test them. They stand also as advocates of the work with the general public, whose confidence in it is naturally increased by the fact that it has in advance the approval of their representatives. I am often indebted to this advisory committee for valuable suggestions, as well as for hearty support.

I am also about to propose to the State Farmers' Institute—a very active and influential body with us—a plan for individual co-operation with the office, not in the making of experiments, but in the practical use of such methods of economic operation as I have worked out to the limit of my opportunity. I hope in this way to establish volunteer demonstration stations in different parts of of the state, from which, as centers, an improved practice may spread to the surrounding communities.

Another subject which has become very practical with us in recent years is that of the legal prevention of the introduction and spread of injurious insects in our territory. We are, I suppose, practically unanimous with respect to the utility, if not the necessity, of the supervision and inspection of nurseries, so conducted as to minimize the danger of dissemination of insect and fungous pests by way of the trade in nursery stock; but we seem not to be equally unanimous with respect to the supervision, under legal authority, of the private property of the fruit grower and the farmer, with a view to the early detection and prompt removal of conditions threatening injury to the property of others. The principle involved seems to me, however, to be virtually the same in the two cases, what difference there is being in favor of the nurseryman. "Let the buyer beware," is a maxim of the common law, and under this one might reasonably expect the purchaser of nursery stock to stand the consequences of his own ignorance and inattention. He does not need to buy a particular lot of stock unless he chooses, and having chosen, it is his to do with as he likes. He may fumigate or spray or destroy it if he finds that he has unwittingly bought an insect infestation with his trees; but the owner of a valuable and well cared for orchard, free from infestation of any kind but lying beside another so infested and neglected as to make it sure that his

own will be invaded by orchard pests to his serious injury, is powerless to protect himself unless he may invoke the aid of the law. He is exposed to needless loss for which he is in no way responsible, and for which his neighbor ought in justice to be held to account. Dangerously infested property is a nuisance, and in my judgment should be universally so treated. It is true, as often said, that education and enlightened principle are in the long run a better reliance than legal compulsion, but the two are not at all incompatible, and we may have both at once. We do not find that laws making forgery or theft a crime weaken the moral sentiment of the community, but quite the contrary; neither will the passage and enforcement of laws making the maintenance of entomological nuisances a misdemeanor operate to diminish the interest of those concerned in means of detecting and measures for destroying such nuisances; they will greatly increase it rather. In my judgment, our San José scale laws are as sound in principle as our statutes concerning the contagious diseases of stock, and I am of the opinion that every entomologist should seek to have these laws strengthened and extended to all like cases, not only as measures of police but as aids to economic education.

I cannot bring to a close this address—already too long, I fear—without congratulating you upon the fact that the economic entomologist has become of recent years in a great measure a guardian of the public's health as well as a protector of its property, and expressing an earnest hope that all of us favorably situated for the purpose may lay a vigorous hold upon the problem of the relations of insects to disease, and particularly, just now, upon that of the house-fly pest—a problem of the first importance which is far from being solved. Medical opinion seems to be coming rapidly to the conclusion that the house-fly is far more dangerous to us than the mosquito, and it is certainly at present much more difficult to control. Some careful studies to this end, continued through the summer and fall under unusually favorable conditions, by a group of assistants in my office, gave us only negative results, reducing us at last to the regular removal of all materials in which house-flies can breed as the only effective means of abating this nuisance; and we found flies breeding in dangerous numbers in a greater variety of situations than we had before supposed. It will be a reproach to economic entomology if we do not soon work this problem out to a finish, and no service which we can render to our kind will be more promptly appreciated or more highly valued.

But the whole country teems with important unsolved problems

in our field, some of them, indeed, as old as agriculture in America; and new ones seem to rise faster than the old are solved. By reason of our past achievements, the country is coming to expect more and more of us, and is yearly more willing to enlarge our opportunities and support our undertakings. Whoever is privileged to look back, from this place, on the work which this Association is to do during the coming fifteen years, will certainly have a most interesting and inspiring retrospect; and, speaking in the spirit of this season of good-will to all, I wish to each and all of you joy in your work, and a large and important share in the investigations and achievements of this coming time.

Afternoon Session, Monday, December 28, 1908

The meeting was called to order by President Forbes at 1.20 p. m. The following paper was presented:

PEMPHIGUS TESSELLATA FITCH

By Edith M. Patch, *Orono, Me.*

The life cycle for comparatively few of the genus Pemphigus is known. Because the egg stage has not been found for many of this genus a tradition has sprung up that the true sexes and egg stage are commonly lacking for Pemphigus.

For several years the common Alder Blight has attracted me for various reasons, and has held my curiosity both because the migrants from the alder in September are indistinguishable from the migrant of *Pemphigus acerifolii* Riley, in July, and because there seemed to be no place in the life cycle of *Pemphigus tessellata* for a migratory generation. The apparent purposelessness of the September migrants from the alder seemed especially strange.

Perhaps a brief statement of the life cycle of *P. tessellata* upon the alder will emphasize this. We have with the first warm days in spring the hibernating generation, hardy, little, partly grown forms, coming up from under the leaves at the base of the alder where they have wintered, and establishing themselves at the alder tips in time for the first sap of the season. These, when mature, become the first of several similar successive generations of apterous viviparous forms. The last of these apterous viviparous generations in the late fall give birth to the hibernating young which completes an apparently sexless cycle for this species.

Another point in regard to giving results statistically, seems to me needs emphasis, although we are all tending that way. With problems requiring extended investigations, the results must be given statistically and with enough fullness to demonstrate the results. Otherwise, they are of very little value when compared in different sections of country and under different conditions. Every important investigation that is made seems to testify to the necessity of such records.

Mr. Hopkins: Mr. President, I regret that I did not arrive in time to hear all of the address, but I want to emphasize the remarks just made in regard to it and in regard to the importance of making observations on resistant varieties of plants. I think there are great possibilities here. It is one of our projects in the investigation of forest insects. I have urged it upon the Forest Service, and it has finally been taken up. It is a thing which has been almost entirely neglected, especially in forestry work in this country. As an example, in making sales of timber from a national forest contractors are required to leave a certain number of trees to the acre for seed trees, without specifying what kind of trees shall be left. Naturally, the worthless scrub trees are left to produce seed. From what we know of the laws governing such things, we can prophesy what will happen if this method is continued. I wish to call especial attention to the Black Hills National Forest, where a very large per cent of the timber has been killed by bark beetles. In that reserve we found trees that had escaped injury. They were entirely immune, apparently. It may have been an accident, but the chances are it was not. These trees are worth thousands of dollars. From what we know of the principles governing such things, these trees should be saved, and the seed should be planted, in order to build up a more resistant race of trees. That is nature's method. The trees more resistant have been perpetuated. This is very important. It should be considered by the entomologists as well as by the plant pathologists.

Mr. Summers: Mr. Chairman, one of the points that was of interest to me was in relation to the protection of one man's property from disease on his neighbor's property. I have not looked over the laws of the different states with this particularly in mind, and I wonder if a good many laws are not so worded today that we have, as inspectors, a good deal of power in that direction—more than is exercised. I know that is true of the Iowa law. It permits the entomologist to enter upon and destroy diseased trees that are dangerous to his neighbors, and that power has been exercised in one or two cases, but the greatest difficulty is that public opinion has not yet reached the point where it will justify any extensive action of that

kind. It seems as if public opinion will have to be raised to a higher standard before the power that at present exists can be exercised so as to have any widespread influence. There is a tendency in that direction, however. I was gratified, during the State Horticultural Society meeting in Iowa a month ago, at the appearance of a paper that I had not heard of until it was presented, recommending the embodying into Iowa law of provisions that would permit of this very thing, the author not knowing that it was already a part of our law which was not enforced.

President Forbes: Mr. Chairman, if you will permit me, in closing this discussion, I would like to say that I had thought of including these statements among those in the address, for the reason that there is just now a very decided pressure upon me, as state entomologist, in that part of the state devoted to commercial horticulture, to do that very thing, and which, in my state, as in Iowa, I have authority to do under the law. In fact, although it was passed as a horticultural measure, our present San José scale law is a very general law, and the attorney-general tells me that I have the power to go into a man's wheat field and ascertain whether he is breeding Hessian flies that are liable to escape to his neighbor's field, and, if he is, I can prescribe any measures I think necessary under the circumstances.

I think very likely we shall find that we have more power than we should want to exercise, unless it is in some such case as that I spoke of in Illinois, where the great mass of the people want to raise fruit and are willing to do what is necessary to that end, but where, here and there, a man abandons the care of his orchard, to the great danger of every one in the vicinity.

(President Forbes took the chair again at this point.)

The remainder of the morning session was devoted to business matters.

President Forbes: Our next topic is "The Economic Status of the House-Fly," by Mr. Felt.

THE ECONOMIC STATUS OF THE HOUSE-FLY

By E. P. Felt, *Albany, N. Y.*

The house-fly is such a common insect that altogether too much has been taken for granted. Up to recently it has been considered simply as an inevitable nuisance. Later developments have shown that this insect may be an important factor in the dissemination of certain diseases.

Typhoid fever is one of the most serious ailments to which man is subject. There are about 250,000 cases of this disease annually in America, about 35,000 proving fatal. Sixty per cent of the deaths in the Franco-Prussian War and 30% of the deaths of the Boer War were caused by this disease. Positive statements have been made to the effect that the house-fly was an active agent in the dissemination of this disease, while certain reputable physicians consider this charge unproved. The Spanish-American War, if it accomplished nothing else, called attention in a most forcible manner to the part flies might play in the dissemination of typhoid bacilli. Dr. M. A. Veeder of Lyons, writing in 1898, was very strongly of the opinion that the house-fly was largely responsible for the dissemination of this disease in camps. Dr. Walter Reed, writing of an outbreak near Porto Principe in the annual report of the War Department, states that the outbreak "was clearly not due to water infection but was transferred from the infected stools of patients to the food by means of flies, the conditions being especially favorable for this manner of dissemination." Dr. L. O. Howard, writing in 1899 on the fauna of human excrement, quotes from Dr. Vaughan, a member of the army typhoid commission, as follows:

27. Flies undoubtedly served as carriers of the infection.

My reasons for believing that flies were active in the dissemination of typhoid may be stated as follows:

a. Flies swarmed over infected fecal matter in the pits and then visited and fed upon the food prepared for the soldiers at the mess tents. In some instances where lime had recently been sprinkled over the contents of the pits, flies with their feet whitened with lime were seen walking over the food.

b. Officers whose mess tents were protected by means of screens suffered proportionately less from typhoid fever than did those whose tents were not so protected.

c. Typhoid fever gradually disappeared in the fall of 1898, with the approach of cold weather, and the consequent disabling of the fly.

It is possible for the fly to carry the typhoid bacillus in two ways. In the first place fecal matter containing the typhoid germ may adhere to the fly and be mechanically transported. In the second place, it is possible that the typhoid bacillus may be carried in the digestive organs of the fly and may be deposited with its excrement.

Dr. Alice Hamilton in 1903, studying the part played by the house-fly in a recent epidemic of typhoid fever in Chicago, which could not be explained wholly by the water supply, nor on the grounds of poverty or ignorance of the inhabitants, captured flies in undrained privies, on the fences of yards, on the walls of two houses and in the room of a typhoid patient and used them to inoculate 18 tubes from

five of which the typhoid bacillus was isolated. She further found that many discharges from typhoid patients were left exposed in privies or yards, and concluded that flies might be an important adjunct in the dissemination of this infection. More recently, Dr. Daniel D. Jackson, investigating in 1907 the pollution of New York harbor, found that by far the greater number of cases occurred within a few blocks of the water front, the outbreak being most severe in the immediate vicinity of sewer outlets. He gives a series of charts showing an almost exact coincidence between the abundance of house-flies and the occurrence of typhoid fever when the dates are set back two months to correspond to the time at which the disease was contracted. The bacilli of typhoid fever were found by Ficker in the dejecta of house-flies 23 days after feeding, while Hamer records the presence of this bacillus in flies during a period of two weeks. Most significant of all, it should be noted that competent physicians in position to make extended observations upon this disease and the methods by which it may become disseminated, are most strongly of the opinion that under certain conditions at least, the fly is a most important factor. Epidemics spread by flies, according to Dr. Veeder, tend to follow the directions of prevailing warm winds. He considers flies the chief medium of conveyance in villages and camps where shallow, open closets are used, thus affording the insects free access to infected material, and where it is possible to eliminate water and milk as the sources of infection. Drs. Sedgwick and Winslow, writing in 1903, state that "the three great means for the transmission of typhoid fever are fingers, food and flies," the authors holding the last to be the most important.

The possibilities of transmitting typhoid fever are appalling to the layman when it is remembered that the germs of this disease may be in the system several weeks before diagnosis is possible, continue in numbers six to eight weeks after apparent recovery, and in exceptional cases may be discharged from the system during a period of several years. There are authentic records of a patient distributing these germs for seventeen years and being the incipient cause of thirteen cases during fourteen years of that period. Furthermore, Dr. M. A. Veeder of Lyons cites a case where typhoid fever was perpetuated from year to year in a locality, ascribing it to a physician recommending the burial of all typhoid excreta and the execution of this direction by a favorite nurse. It is well known that soil infected by these germs may be the origin of new cases, and Dr. Veeder significantly observes that the annual recurrence of typhoid fever in the above mentioned locality ceased with the death

of the two parties mentioned above and a change in the method of disposing of typhoid discharges.

The evidence against this insect may, therefore, be summed up briefly as follows: Virulent typhoid bacilli have been found upon the legs and within the bodies of this insect, persisting in the latter case for 23 days. A number of serious outbreaks have been observed by competent physicians, where infection through a common water or food supply did not satisfactorily explain the trouble. This positive evidence, while not establishing beyond all question the culpability of the fly, is further supported by the opinion of a number of reputable physicians who have had extensive experience with outbreaks of this character.

The evidence showing that flies may play an important part in the diffusion of cholera is, according to Dr. Nuttall, absolutely convincing. He cites experiments showing that cholera bacilli may be found on flies in large numbers, while they may occur in the dejecta within 17 hours after feeding and as late as four days. Infected flies have been given access to milk and cholera cultures made therefrom.

Typhoid fever and cholera, while both serious infections, are by no means the only diseases which may be conveyed by flies. Certain forms of diarrhœa and enteritis are undoubtedly due to specific germs, and there is no reason why the bacilli causing these infections may not be carried as easily and in the same way as those responsible for typhoid fever. The monthly bulletin of the New York State Department of Health for October, 1908, states that during 1907 there were in New York state 37,370 deaths of infants under two years of age, 9,213 being due to diarrhœa and enteritis. Careful investigators, it is stated, have placed the proportion of deaths between bottle-fed and breast-fed babies as 25 to 1. Physicians recognize the necessity of providing pure milk for young children, and in most instances it is comparatively easy to see how flies might be responsible for the major portion of the infections, since they usually occur in numbers about stables, in the vicinity of milk houses, in the neighborhood of milk stations, on milk wagons and, in fact, are found in greater or less numbers wherever milk is stored. Martin states that each succeeding year confirms his observation of 1898 to the effect that the annual epidemic of diarrhœa and typhoid is connected with the appearance of the common house-fly, while Nash in *The Lancet*, records no mortality from diarrhœa among infants at Southend during July and August, 1902, this immunity being accompanied by the almost complete absence of the house-fly. This insect was abundant in that locality in September and coincidentally epidemic

diarrhœa developed. Sandilands, in the *Journal of Hygiene* states that the great majority of cases of diarrhœa are due to the consumption of infected food, and suggests that the seasonal incidence of diarrhœa coincides with, and results from, the seasonal prevalence of flies. Dr. Jackson records several epidemics of a malignant type of dysentery radiating from a single point and disappearing entirely when proper disinfection of closets was enforced.

The evil possibilities of the fly are by no means exhausted in the above recital. It is well known that flies feed upon sputum. Experiments by Lord recorded in the *Boston Medical and Surgical Journal* show that flies may ingest tubercular sputum and excrete tubercular bacilli, the virulence of which may last for at least 15 days. He considers the danger of human infection from this source to lie in the ingestion of fly specks on food, and suggests that during the fly season great attention should be paid to the screening of rooms and hospital wards containing patients with tuberculosis and laboratories where tubercular material is examined.

Nuttall considers that the evidence previously submitted proves that the house-fly may carry about and deposit anthrax bacilli, though there may be a question as to how generally flies are responsible for the dissemination of this disease. Parke admits the possibilities of flies distributing, in addition to those mentioned above, plague, trachoma, septicemia, erysipelas and leprosy. Furthermore, there are those who would hold flies responsible for the more frequent new cases which occur in a zone immediately surrounding the smallpox hospital and which may be due either to the wafting out of infected particles or their carriage by flies. The latter is considered the more probable. Howe, according to the statement of Dr. Howard, has demonstrated that the purulent conjunctivitis of the Egyptians is spread by the house-fly. The experiments of Grassi show that the eggs of Taenia, Trichocephalus and Oxyuris pass uninjured through the alimentary tract of flies.

A word respecting the dissemination of flies may not be out of place in this connnection. The experiments by Dr. L. O. Howard several years ago illustrated in a striking manner the possibilities of reducing the number of flies by giving adequate treatment to accumulations of manure in the vicinity. This is very satisfactory so far as reducing the annoyance caused by flies is concerned. There is a phase of this question which has apparently received little consideration, namely, the conveyance of flies by vehicles of one kind or another. It only requires a little observation to convince one's self that the butcher cart of the country is a very efficient carrier of flies, pre-

sumably receiving accessions and leaving individuals at almost every stopping place, even though the route traversed may occupy an entire day. Furthermore, trolley cars and, to a more limited extent, express cars carrying sacked meat or other supplies attractive to flies, may become important factors in the conveyance of disease-bearing flies. It is only necessary for these carriers to load where conditions are favorable for the infection of flies and we may have a mysterious outbreak at some distance from the source of trouble.

It is admitted that flies are comparatively harmless if they have no chance of becoming infected. The difficulty is to distinguish between the harmless individual and the one fairly reeking with typhoid germs or some other undesirable infection. Dr. Howard's experiments have shown the practicability of reducing largely the numbers of this ubiquitous pest, while medical science is in position to instruct respecting the care of all infectious material. Coöperation on the part of both with general support from laymen throughout the country should result in a material betterment of conditions.

President Forbes: Any discussion of this paper?

Mr. Washburn: In connection with Dr. Felt's paper, I should like to ask if any one has definite information on this point. Several years ago, after the Spanish War, the statement was made, I think in a meeting of this Association, that we lost by Spanish bullets only 250 men, whereas by the agency of the house-fly we lost 5,000. Now, I don't think Dr. Skinner would like to be quoted here on that subject, but I should like to ask whether that is an exact statement or only a broad estimate.

Mr. Britton: Mr. Chairman, I might say that one of our young members was a soldier in camp at Chickamauga, and that he worked for me two or three years. He tells me that the sinks there were wholly unprotected and that a large proportion of the soldiers contracted typhoid fever, and that no precautions were taken to protect them from the flies, which fairly swarmed over the excrement and later over the food in the mess tents, until some of the authorities from Washington went down there. After that, it was changed, of course. But that seems like an unnecessary neglect on the part of the officials in charge of the camp. The men were there, and they had nothing to do except to keep the camp as clean as possible, and it seems almost like criminal negligence to have allowed such a condition to exist.

Mr. Washburn: It seems to me, in this connection, that the en-

forcement of the anti-spitting ordinances on the street cars and in various other public places might come in for some attention, and if flies do spread disease from sputum, as they probably do, it is singular that in localities where spitting on the sidewalk is more prevalent we do not find more of those diseases than in others where the laws are more strictly enforced.

MR. HUNTER: Mr. President, I don't think that Dr. Felt exaggerated the importance of this subject at all. On the contrary, I am inclined to think that he went to the other extreme in minimizing the importance of the house-fly in the spread of diseases. Recently, some work was done in the Hawaiian Islands by Dr. Cobb, not with the house-fly, but with an insect instrumental in the dissemination of a disease of the sugar cane. The results of his work throw a great deal of light upon general matters connected with the transmission of diseases by flies. He found that the excreta of a Sarcophagid fly served as a perfect cultural media for the germs passing through the alimentary canal. Each defecation therefore provides a medium that augments greatly the chances of the spores taking hold of the plant. This refers to an entirely different fly, but isn't it possible that in the case of the house-fly something very similar takes place? That opens up an entirely new category of conditions under which the house-fly may transmit diseases. Dr. Felt, I think, did not mention one case of the transmission of disease by flies, brought to the surface recently by physicians connected with the British Army Corps in India. In India, in Ceylon, and the Philippine Islands, they have a troublesome disease called yaws. Dr. Robertson, of the British service, having charge of a camp in the regions infected with yaws, tried the experiment of carrying the infection by meats and flies. The patients were instructed from time to time to anoint their sores with a certain preparation, but during the course of this experiment to do nothing of the kind, but to collect all the house-flies they could, and they collected 200 specimens of the house-fly, which were put into distilled water and shaken up. A dozen flies were taken from the water in the flask, and they showed the specific organism, the cause of the disease. The connection between house-flies and tuberculosis is given entirely too little attention. A great deal has been written and said respecting flies and typhoid fever, but it occurs to me that when the matter is gone into more thoroughly, we shall find flies much more important and dangerous in the transmission of tuberculosis.

PRESIDENT FORBES: If there is nothing further on this subject, we will take next the paper on "Notes on Cranberry Pests," by H. J. Franklin, which will be read by Mr. H. T. Fernald.

MR. FERNALD: A word of explanation is perhaps due to account for my presenting this paper. The work on this subject was done in Massachusetts by Dr. Franklin before he went to Minnesota, and, through the kindness of Professor Washburn, it has been sent to me, simply because I represent the state where the work was done.

NOTES ON CRANBERRY PESTS

By HENRY J. FRANKLIN, *Saint Anthony Park, Minn.*

In studying the life histories of various cranberry bog insects on Cape Cod during the season of 1907, certain interesting points were discovered concerning the life history of *Peronea minuta* (Robinson) which do not appear to have been published. This insect is two-brooded in Massachusetts and three-brooded in New Jersey. The winter brood of moths in Massachusetts are slate gray in color, but the summer brood are orange red. In New Jersey also, the winter brood is slate gray, but the two summer broods are both orange red in color.

The fact that the species is dimorphic in the adult state has been long recognized, and Prof. J. B. Smith has recorded (Farmers' Bul. No. 178, U. S. Dept. Agric., p. 13) a marked dimorphism on the part of the larvae. Speaking of the last brood of worms in New Jersey he says: "Eggs laid by these moths" (those of the last summer brood) "do not hatch until in August or even early September, and the worms that come out of them grow slowly as compared with the earlier broods. Few of them spin up more than a single shoot, and few of them eat into any but the smallest berries. They also tend to become reddish in color and even striped, so that at one time they were believed to form a distinct species, described as the 'red-striped cranberry worm.'" In this we find a difference not only in color, but also in habit, as the worms of the other two broods are pale yellow in color and those of at least one of these broods usually draw together a number of shoots in a single web and eat into the fruit voraciously. In Massachusetts as well as in New Jersey this last brood of worms, which later changes into the winter brood of moths, has a tendency to "become reddish and even striped" and grows slowly as compared with the caterpillars of the other brood. In Massachusetts, however, this brood of worms is the one which is often very injurious to the vines and the berries. This difference in habit between Massachusetts and New Jersey is doubtless due to the fact that the cranberry

vines are not in the same condition in both regions during the time that this brood of worms is at work.

In Massachusetts, the second brood of worms all have yellow heads in all stages of their development, and when they first hatch from the egg they do not burrow into the tissues of the leaves on which they feed, but they leave the egg-shell through a circular exit-hole and go at once into the higher portions of the vines and commence to spin up the tips. The first brood, on the other hand, have considerably darkened heads in their early stages and may readily be mistaken for young larvæ of the Blackhead Cranberry Worm (*Eudemis vacciniana*). Like the young caterpillars of that species they bore straight into the tissues of the leaves on which they hatch, destroying the egg-shells in the operation and leaving a pile of frass over their entrance holes. They work around within the tissues of the leaves for some time before they leave them to go in to the tips of the vines. Some of the worms of this brood continue to have somewhat darkened heads until they become full grown. It would be interesting to know if the first brood of the worms of this species in New Jersey present the same peculiarities of habit and appearance that they do on Cape Cod and also if the second brood agrees with the first one in these respects.

A comparison of the pupation habits of the fire worm (*Eudemis vacciniana*) on Cape Cod and in Wisconsin is interesting. On Cape Cod the worms of both broods of this species go down out of the vines on to the surface of the bog to pupate on the sand and among the fallen leaves. In Wisconsin, on the other hand, (Cf. C. B. Hardenberg, Bul. No. 159 of the Wisconsin Experiment Station, page 7), these worms usually pupate in the spun up tips of the vines, only a small percentage passing the pupa stage on the surface of the bog under the vines. The bogs of Cape Cod are as a rule well drained, while those of Wisconsin are not, and it is probable that the dampness of the bog surfaces in Wisconsin makes them unsuitable localities for the insect to pupate in. It would be interesting to know, however, if this difference in pupation is a real inherent difference of habit or a difference forced upon the insect by the surrounding conditions.

It was found to be a common thing, on the strictly dry bogs of Cape Cod, for certain undetermined species of ants to collect both yellow-headed cranberry worms and fruit worms in large numbers and take them to their nests, presumably as food. I several times saw as many as fifty such worms, all at one time and within a radius of twelve feet, being dragged along by these ants, the ants as a rule

working singly. It is certainly advisable that the nests of these valuable allies of man should not be disturbed by the cranberry grower, and these observations suggest the possibility of developing the use of ants as a means of combating these pests on dry bogs, either by encouraging the species already present, possibly by the use of artificial nests, or if possible, by the introduction of some closely allied but more prolific species.

President Forbes: Any discussion of this paper?

Mr. R. L. Webster: Mr. President, I was very much interested in the remarks on the cranberry worm, inasmuch as I have just finished some experiments on its life history in Iowa, where the insect is a pest on apple stock in the nursery. In southern Iowa, and as far north as Des Moines, this species is three-brooded, and there was no indication of the difference in the color, either in the head or in the general color of the larvæ. I found no larvæ on apple, which I could call red-striped, in any sense of the word. The three broods, as far as I could see, all had the same appearance.

Early in the spring, I found eggs only on the lower part of the apple trees in the nursery. They seemed to be deposited before the leaves had come out very far on the trees, all on the lower part of the trees, perhaps within a foot or six inches from the ground. In this way, only the lower limbs on the trees were infested. The leaves higher up did not have any larvæ at all. The remaining two broods deposited eggs, as far as I could determine, on the leaves. I saw none at all on the limbs, as in the case with the first brood. In the second and third broods the larvæ seemed to be feeding all over the trees, principally in the tips of the young growing leaves. The first and second broods of moths were the orange form, and the last brood the slate form as in New Jersey.

President Forbes: Anything further on this subject?

Mr. Hopkins: Mr. President, I think the matter has come up before this Society before, and while we are considering the matter of nomenclature, we ought to settle on the use of the terms "brood" and "generation." Sometimes it is necessary to refer to the particular brood. It seems to me there ought to be a certain uniformity.

President Forbes: The following paper will now be presented: "An Example of Forest Insect Control at a Profit," by Mr. A. D. Hopkins.

A. D. Hopkins: Mr. President, I did not expect to present this paper, but, owing to the fact that a rather striking example was

reported recently. I took these extracts from manuscripts already prepared in order to call attention to the fact that some of our most destructive forest insects can be controlled without cost, and often at a profit.

AN EXAMPLE OF FOREST INSECT CONTROL AT A PROFIT

By A. D. Hopkins, *Washington, D. C.*

In May, 1907, Mr. W. D. Edmonston, a forest ranger, detailed from the forest service to the Bureau of Entomology, to work under our instructions in the location of evidences of beetle infestation in the National Forests of Colorado and adjoining states, reported that the pine timber was dying on a large estate not far from Idaho Springs, Colorado, and in the adjoining Pikes Peak National Forest. Mr. Edmonston was then instructed to make more detailed examinations, after which he reported that some 63,000 feet of standing timber on the estate was infested by the Black Hills beetle and that unless the ravages were checked at once it would kill the timber not only on this estate, but that on the adjoining estates and National Forest. The owner of the property was advised by the Bureau of Entomology to take radical action according to a special recommendation and detailed instructions relating to a necessary control policy. No action was taken, however, before the first of the following July, and therefore not in time to prevent the broods of beetles from swarming from the infested trees and extending their ravages. In December, 1907, Mr. Edmonston was instructed to make another examination of the timber, when he found that his prediction was being fulfilled, and that instead of 65,000 feet of timber in the old infestation, there was nearly four times as much timber involved in the new, or over 250,000 feet. The owner was again notified of the serious character of the outbreak, and the further suggestion made that if the logs from the infested trees were converted into lumber and the slabs burned before May, 1908, it would result in the protection of the remaining living timber. Immediate steps were then taken by the owners to carry out the original recommendations. Mr. Edmonston gave instructions to the manager of the estate in locating and marking the infested trees and in the essential features in the methods of utilization to destroy the necessary number of beetles. He also marked the infested timber on an adjoining estate and on the National Forest. Five months later, in May, 1908, Mr. Edmonston reported that the larger clumps of infested trees on the estate had been converted into lumber and the slabs burned, and that the

marked trees on the adjoining estate and National Forest had been cut and barked. In November, 1908, Mr. Edmonston was instructed to make another inspection of the forest on the estate and surrounding area, and on December 1 he reported: "Nothing could be more satisfactory than the results obtained by the cutting of the infested timber on the estate. Your recommendations and instructions submitted to the owner, and carefully followed by the manager of the estate, have clearly demonstrated that insect infestation can be controlled and at no expense to the owner of the timber involved, in fact a very satisfactory price was realized, resulting in a net profit, I understand, of $5 per thousand feet, board measure, on the 240,000 feet cut. This, of course, does not include the profit of the milling operations, but for the logs sold at the mill, after deducting the expenses of cutting and logging. The sawmill was owned and operated by an Idaho Springs firm, and the manufactured article sold in that town. I spent six days on the estate, November 18th to 23d. After a very thorough examination of the timber, I found only three infested trees, isolated individuals, and over a mile from where the large clumps of infested trees were cut. With the exception of those three trees, there is no new infestation on the estate. I also examined the adjoining lands, but no new infestation was observed. The infested trees which I marked in December, 1907, had all been cut and barked. On the Pike National Forest, contiguous to the first mentioned estate, where you will remember I marked some clumps of infested trees, no new infestation was found, not one tree. I found that all the infested trees had been cut and barked. Ranger Kelso had charge of this work, and it has been quite thoroughly done."

This most gratifying result demonstrated two important things: one, that a quite extensive outbreak by one of the Dendroctonus beetles involving more than 1,000 trees can be controlled without expense, and even at a profit, whenever the conditions are favorable for the utilization of the infested timber; the other, that the essential details of the recommendations and expert advice based on the results of scientific research can be successfully applied by a manager of a private forest and the rangers of national and state forests. It also indicates quite conclusively that the widespread depredations in the Black Hills Forest Reserve could have been prevented with very little expense to the government if the matter had received prompt attention in 1901, when the first investigations were made and essentially the same recommendations submitted. But, through the lack of public appreciation of the importance of the problem at the

time, and the lack of sufficient authority and funds later, it was allowed to extend beyond practical control and in consequence a large part of the timber of the entire National Forest has been killed. There were then no forcible examples of the practical value of such recommendations based on scientific research and no other argument was effective in arousing public interest in the threatening character of the outbreak or confidence in scientific advice or methods or control. Now we have several examples demonstrating the practicability of forest insect control in America which should lead to confidence in the results of research as a basis for success in practical application.

PRESIDENT FORBES: Remarks on this paper are now in order.

MR. WASHBURN: What is the annual loss from *D. ponderosæ?*

MR. HOPKINS: About a billion feet has been killed in the Black Hills National Forest and at least 10% of the matured timber in the southern half of the Rocky Mountain region within recent years.

PRESIDENT FORBES: The Association may perhaps be interested to know the results of some forestry insect work that we have done this last season in Illinois. Our situation is a little peculiar there in that respect. Although state entomologist, I am also charged by the state law with the natural history survey of the state, which is directed primarily to economic and educational ends, and among the enterprises which we have lately taken up under the impulse of this conservation movement, which has led to consultations of governors, experiment station workers and others, has been a forestry survey of the "Prairie State." We are not supposed to have any forests in Illinois, but, nevertheless, we have enough there to make it worth while to take care of them and to increase the supply of local timber.

Arrangements were made for one of the United States forest rangers to go into one of our tracts, and he made a careful expert examination of them, at an expense which was shared by the natural history survey of the state and the forest service. One of our own force, who had special training in this line, went with this ranger. When the reports came in, it was found that the insect problem was really the most serious of the whole situation, and that as many as ninety per cent, in some cases, of the forest trees standing on these selected areas were infested by borers to such an extent as to make them practically worthless, because following the insect infestation, came invasions by fungi and internal tree rots and the like, which rendered the timber very short lived. I think that any of us who

work in the field will find that insect infestation will be one of the great problems we shall have to deal with in order to accomplish anything either toward the development or maintenance of existing forests. It was a great surprise to all of us. It was found that as the forest lands were being cleared of the remnants of the forest operations by timber cutting, the insects were obliged to confine their operations to the constantly decreasing area of trees, and these depredations upon the smaller areas became so great that insects which originally infested a considerable extent of territory were gradually being herded into smaller areas, to such an extent that it began to look as though there was nothing there but bugs.

A. D. Hopkins: Mr. President, I want to thank you sincerely for this talk on the forest insects. This is, I believe, practically the first time any one has supported the idea that forest insects are really important; it is most gratifying. Evidence is piling up that insects are causing more actual financial loss, to merchantable timber, than is being caused by forest fires to the same class of timber. I am willing to stake my reputation that this is true, so far as affecting matured timber is concerned, not the reproduction. Of course, there is no way to be positive as to cash value, because we have many complications to figure on, but every evidence indicates that the annual loss by insects to forests in the United States exceeds a hundred million dollars in value. Insects make no show like the smoke coming from the fire, though they are quietly working away on the matured timber and causing a little injury every year, so that in the course of a period of years there is an accumulation of injury not seen until the timber is sawed up, and then the real loss is apparent. Of course, in the West square miles of timber are often killed by insects within one or two years. We hope that forest insects will before long receive their due share of attention.

Mr. Bruner: Mr. President, I want to add to what Dr. Hopkins has said with reference to the destruction of mature timber, since I spent considerable time several years ago in investigating the destruction of trees, on tree claims in the West. I found, in most cases, that the failure to have the proper number of trees at the end of the period was due entirely to the work of insects. Propagation of forest trees is largely held in check by insects of various kinds; those that work on small trees. I became interested in the insects that were attacking young trees at the time of studying this problem of the tree claim insect pests. I have still continued to hold that interest, and have noticed, wherever I go in the forests, that immense numbers of young trees are annually being destroyed by insects of

various kinds, not only by species that defoliate trees, but those that work in the trunk and by insects that devour the seeds. I have been trying to persuade our forestry school at the University of Nebraska that the study of insects, in their relation to forestry, was one of the most important features they had at the school. I can agree with Dr. Hopkins that the insects are far more important in destroying our forests than fires.

I have made observations also in relation to the wiping out of Dendroctonus in various parts of the Rocky Mountain region. One instance in mind is an estate of pretty nearly 100,000 acres in the southern part of Colorado, where the cleaning out of about eighteen hundred trees according to the directions of Dr. Hopkins prevented the spread of Dendroctonus on the estate. I visited the estate two successive years, and found that the insect, while not exterminated, had been so thoroughly cleaned out, that the birds were able to take care of the remainder. I found four trees in a portion of the estate that were not taken out at the time the general clean-up was made. The birds had found those trees and cleaned them to such an extent that it was almost impossible to find specimens for the cabinet.

A MEMBER: Mr. President, I would like to ask Dr. Hopkins whether our forest insects are confined more to the evergreens than to the hard wood growth.

MR. HOPKINS: The damage is far more conspicuous in the conifers, but I believe, in taking the average, that the hard woods will show an equal, if not a greater, loss. Chestnut timber, especially throughout the eastern United States, is damaged from twenty-five to fifty per cent, in the aggregate. Matured oaks, red and white, are injured by timber worms and their value greatly reduced. Nearly all the hard woods suffer more or less, and the product is reduced in value by work that is not conspicuous; but in the conifers, where Dendroctonus beetles attack the trees, it is conspicuous.

MR. COOLEY: Mr. President, I would like to add that a large per cent of the seeds of forest trees are destroyed annually in Montana by an insect resembling the larva of the codling moth. In some cases over ninety per cent are destroyed. I have had this matter under observation for several years.

MR. HOPKINS: I am very glad to learn that you are studying that insect. It is specially destructive to the seeds of *Pinus ponderosa*. I do not know that the species has been positively identified.

PRESIDENT FORBES: The next paper will be "Notes on *Empoasca mali* LeB.," by Mr. F. L. Washburn.

NOTES ON EMPOASCA MALI LEB.

By F. L. Washburn, *St. Anthony Park, Minn.*

The following observations resulting from two years' work with the above named insect, illustrate, it is believed, some hitherto unknown facts in connection with its life history. These points are best discussed under separate headings, namely: 1. The Fall-Laid Egg; 2. Oviposition during the Summer Months; 3. Food Plants; 4. Different Stages and Number of Broods; 5. Economic Suggestions.

1. **The Fall-Laid Egg:** The finding of egg blisters on young apple trees in 1907 was reported before this Association at the last annual meeting, and pictures of the blisters exhibited. That paper, with illustrations, was published in Vol. 1, No. 2, of the Journal of Economic Entomology. The blisters shown in that article measured about .75 mm. long by .4 mm. broad, and the fact that Empoasca was reared from them authorizes the statement that they belonged to this species. These blisters were found upon the apple. Certain egg blisters on the small branches of the elm, similarly located with respect to the new growth of the elm, were found this year by Doctor Franklin, and they appear to be the same as the blisters found upon the apple. We were able to discover no difference between these and the apple blisters, the measurements were the same, and they were the same in general appearance. The contained eggs were like those contained in the blisters on the apple. It seems possible that these are also blisters of *E. mali*, or perhaps some very closely allied form. The fact that the elm and the apple are not closely related may not be taken as evidence against this, for it is quite possible that the character of the bark which the tree bears on its small branches may have a more important bearing upon this matter than does the relationship of the species. The egg contained in the blister upon the apple is about as long as the blister itself, hyaline and semi-opaque. It is covered by the epidermis and the corky portion of the bark, and only a thin layer of cortical parenchyma. The eggs are much narrower than their blister-like envelope, measuring only .2 mm. in their greatest width. In cross section they are nearly circular, slightly curved from end to end, and round at the points. Further, they are of about

Explanation of Plate 2: Figs. 1, 2, 3, 4 and 5 represent five successive stages of the nymph; Fig. 6, the adult leaf hopper; Fig. 7, the newly hatched nymph (summer) issuing from petiole of clover. The central figure illustrates the appearance of the terminal portion of an apple twig upon which this leaf hopper is working. (Reprint from 12th Rept., State Ent., Minn. 1908.)

equal width throughout their length. The shell, as one would naturally expect, is very delicate, and the egg is dissected out of the bark with difficulty.

These eggs, when first examined, were filled with a semi-transparent liquid material, which was broken up somewhat into small globules. When collected and examined later, on November 2d, many of them were still in this condition, and many were somewhat cloudy within, in spots, and in some the young nymph, though still very small, could be seen to have already taken form. At that time these nymphs were white in color, and occupied only a very small part of the interior of the egg. They could be seen to move very slightly now and then.

We have been unable to find fall-laid eggs in any herbaceous plants, though many such which were swarming with Empoasca during the summer, were most carefully examined in the fall. It is believed from the following observations that in Minnesota these fall eggs are laid from the middle to the latter part of September. Egg pockets (measurements of which correspond exactly to those on nursery stock from which *E. mali* was reared) were first found in abundance September 23 upon the smaller branches of apple trees in an orchard eight years old, located next to an alfalfa field which was very heavily infested with *E. mali* during the summer. Each pocket or blister contained a single egg, apparently fresh. At that date the hoppers were less abundant in this alfalfa field than they had been, and had been growing markedly less throughout the latter half of September. This field was swept with a collecting net as late as November 4, and at no time was *E. mali* found in abundance, only a few specimens being taken at a sweeping. This is to be regarded as evidence that it does not winter in the adult or any other but the egg stage, since none were found November 4.

The above-mentioned blisters, containing fall-laid eggs, were found throughout the orchard referred to, but were apparently most numerous on the side adjoining the alfalfa field. They were most plentiful on the second and third years' growth from the present, according to Doctor Franklin's report, though he found them occasionally on the growth next to the present year's growth, and they were often found to be rather numerous on the fifth year's growth from the present. Only one egg blister which appeared to be that of *E. mali* was found on last season's growth. Distance from the ground does not appear to have the influence on the position of the egg blister which one might expect. To be sure, they seem to be more abundant on the lower branches, but the upper branches also seem to have a considerable supply; for instance, different heights were examined, and

blisters were found as high as seventeen feet and three inches from the ground. Two branches over twenty feet high were examined, but no blisters were found thereon. It seems probable that adults choose for fall laying those portions of the tree where blisters are found to be most numerous because those portions are in the condition best suited to protect the eggs and at the same time tender enough to make ovipositing easy. The newest growth is not chosen, possibly either because its bark is not dense enough to afford satisfactory protection from winter weather, or because its more rapid growth might crush the eggs. It may be said here that after the emergence of the nymph the hole which affords it exit narrows to a barely discernible horizontal slit.

2. **Oviposition During the Summer Months:** The petiole of apple and the petiole of clover have been found to be used for egg-laying during the summer. Apparently the egg is placed longitudinally in about the center of the petiole. Fig. 7 on the colored plate shows a nymph emerging from petiole of clover, as observed by us this year.

Since this insect swarms in all stages during the summer on a large variety of herbaceous plants, it seems fair to conclude that many such plants harbor summer eggs. Dahlias examined September 30 had adults and nymphs upon stem and petiole, and the minute slit-like scars above referred to were found on these plants. In 1907 Mr. Ainslie found what appeared to be similar scars on petioles of buckwheat growing in a nursery.

3. **Food Plants:** In addition to the apple and clover we find the insect in summer on plum, maple, bur-oak, black oak, thorn apple, basswood, hazel, box elder, choke cherry, sumac, European birch, cut-leaf birch, syringa, snowball, Carragana, raspberry, blackberry, beans, corn, alfalfa, sugar beets, buckwheat, dahlia, hemp, rhubarb, potatoes, different grasses, etc. Doubtless this list can be largely added to, and as pointed out above, it is more than probable that egg-laying takes place during the summer upon many of these plants. Field beans and alfalfa upon the Experiment Station grounds were both badly injured this year by *E. mali*.

4. **Different Stages and Number of Broods:** The finding of five nymphal stages in 1907 (see figures on colored plate) was corroborated by observances in 1908. An insectary experiment as to the length of life in each stage resulted in the following: First stage, three to five days; second stage, one day; third stage, six days; fourth stage, six days; fifth stage, four days, or an average of twenty-two days from egg to adult. Too much reliance must not be placed upon these data, as they are the result of one experiment only, though it is

interesting to note that the 1908 observance, as far as total time is concerned, was practically corroborated by the work of 1907, when it was found that the insect spent from nineteen to twenty-five days in nymphal stages, although Mr. Webster, in 1907, did not determine the length of time spent in each stage. Insectary observations in 1908 indicate that the adult may live at least fourteen days. Its length of life is probably much longer, for experiments in 1907 indicate that it may live more than twice that length of time. There are surely two broods of *Empoasca mali* during the season in Minnesota, and almost certainly three. It is easy to define the first two broods, which are fairly well separated. Allowing forty days for each cycle, which seems a fair estimate from the data we have at hand, and bearing in mind that they first appear about May 25 (1907), or soon after the leaves open, we would have, in round numbers, one hundred and twenty days, to September 25 (at about which time adults grew appreciably less in numbers), permitting of three such cycles. This estimate is, necessarily, crude.

5. **Economic Suggestions:** Though the leaf hopper is found in abundance on trees in apple orchards, the most and perhaps the only serious results of its work along commercial lines are on nursery stock. As remarked by a very large grower in our state, "the trade requires a nursery tree between five and six feet high. This standard could be reached in three years if it were not for the leaf hopper, which so retards the growth of nursery stock that we cannot market a tree until it is four years old." This statement is generally true for Minnesota (though there are years when the hopper is not so numerous and some localities where it is not particularly troublesome). The nursery of the above grower happens to be one of the worst afflicted nurseries in the state in this connection. Since the winter egg is laid on the apple, it would appear that one means of lessening the attack on nursery stock, or at least delaying the attack, would be to locate said stock at a distance from apple orchards. Secondly, though this is by no means so feasible, to locate nurseries as far as possible from other growths which serve as food plants during the summer. This suggestion naturally includes the keeping of nursery ground free from grasses and weeds which harbor Empoasca during the summer. If, in connection with this partial isolation of nursery stock, a grower uses Bordeaux frequently (as he might for plant diseases), it would seem that it might act in a measure as a repellent.

In order to kill a large proportion of the first brood, it is desirable to collect the adults with some form of hopper dozer, sticky

shields, for instance, every day for a week at the time they first appear. We have made use of sticky shields with good results. A light frame was made three by four feet, with handles, covered with heavy cloth, and smeared with tree tanglefoot. A thinner grade of tanglefoot than this might have been used advantageously. Two men were employed in this work, one man holding the frame and walking down one side of the row of trees, while the second jarred the trees from the other side. Two men in ten minutes covered two hundred and ninety feet in a row, and an actual count of hoppers caught in the ten minutes was 3,221. About 95 per cent of these were adults.

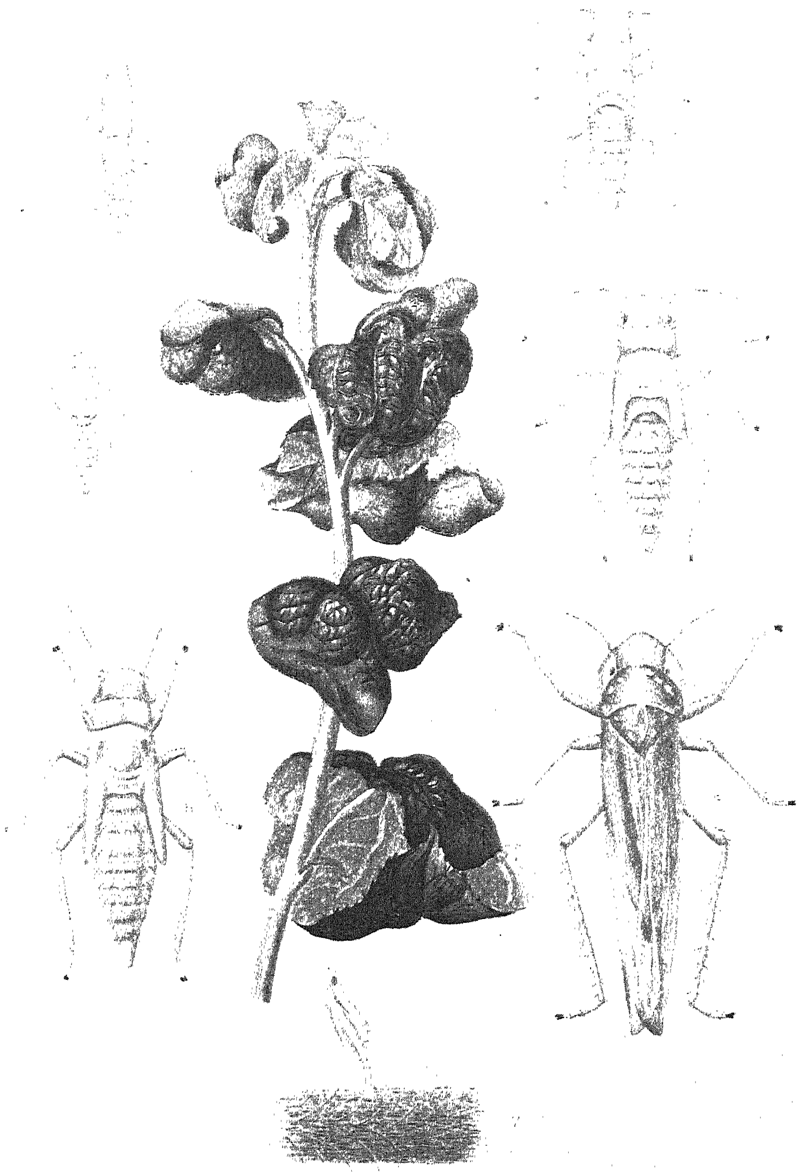
Spraying the trees with any compound does not seem advisable, on account of the difficulty of hitting the insects in the curled leaves, but we found that a spray of one pound of fish-oil soap in ten gallons of water killed both adults and young, when not too well concealed in the leaves.

For use on experimental plots, we constructed a hopper dozer, with a metal pan to hold petroleum. By once employing this on alfalfa plants we believe we killed nearly 50 per cent of the insects present at that time, and it would seem that it could be used to advantage on a commercial scale with any low-growing plants set in rows.

PRESIDENT FORBES: Discussion is next.

MR. R. L. WEBSTER: Mr. President, I would like to make a few remarks on the number of broods, comparing Minnesota conditions with Iowa conditions. I see Professor Washburn has succeeded in getting only three broods. I have pretty conclusive evidence that in Iowa we have five broods. That is, at the rate of one brood for every month. About once a month, I think it is the last few days of one month and the first few days of the next, they appear on the young tender shoots on apple stock, as shown by the curling leaves, which is coincident with the appearance of the newly hatched insects. The leaves first come out in southern Iowa about the latter part of April, and with them appears the first brood of young leaf hoppers. The insect winters in the egg stage, as it does in Minnesota. Counting one brood a month, by the first of September we have five broods, and the winter eggs are deposited in the bark about the first week in October. I found them at Charles City, about the sixth of October, thus making five broods.

MR. WASHBURN: It is very strange that we found clusters on the 23d of September. I don't know why we should. Of course, being further north, they would begin laying their eggs sooner. This was at St. Anthony Park.



I. L. WOOD, del. A. HOEN & CO. BALTIMORE

APPLE LEAF HOPPER.

(WASHBURN, MINN. EXP. STA.)

A MEMBER: I would like to ask Professor Washburn if these insects are attracted by light and whether that can be made use of. Can they be attracted by gasoline torches at night? I have noticed that some species are attracted by light.

MR. WASHBURN: That opens up an interesting question. I don't know.

MR. SMITH: Mr. Chairman, I know that this particular species is very strongly attracted to light, but I don't think that is true of the grape leaf-hopper.

PRESIDENT FORBES: If there is nothing further, we will take up the next subject: "Do We Need the Insectary?"—a general discussion to be opened by Mr. E. D. Sanderson.

DO WE NEED THE INSECTARY?

MR. SANDERSON: Mr. President, I have not prepared a paper. I brought up the subject because I wanted to hear a discussion and wished to get the views of some of those present upon the matter. In my own training, I came to believe that I must have an insectary. I have been trying to get one at every place I have been, and have never succeeded, but I have managed to get along without one. The more breeding I have done indoors and compared with records made out of doors, the more I have found that there was considerable difference in the life histories which were obtained by breeding indoors from those secured out of doors. In looking at insectaries at different places in the country, I very often found them practically out of use. In the summertime they are too hot. It is very difficult to grow things. In the wintertime there is very little work going on. There is very little occasion for using a heated insectary in winter, unless a man is engaged in special investigation on something that can be bred during the winter. In studying the work of the Gypsy Moth Parasite Laboratory, I was very much impressed with their outfit for rearing insects. Most of you are familiar with it from Mr. Burgess' description in the JOURNAL OF ECONOMIC ENTOMOLOGY, and many of you have seen it. The house consists simply of a frame set directly on the ground with wire screening on the sides and a canvas top. The cages for rearing Carabid beetles are set in the ground and trays are used for rearing caterpillars. In the fall the insect material can be removed if desired, and the house stripped for the winter. I believe this outfit is in a process of evolution. It has a considerable history, if I am not mistaken, for I know that large cages have been used in the field for several years by various workers. I have been wondering whether it would not be better for us

to use an outfit like this, making it something on the order of a small greenhouse: possibly in sections, with simple wire sides and screens, and with top of canvas or of prepared roofing, such as is used for sky-lights. This will give us just about as near outside conditions of temperature and moisture as possible. Would it not serve every purpose of the insectary and even be better than the glass house? I think it is a question which will bear considerable discussion. I have been considering building such a house for our work out of doors, and I should like to hear the experience of those here, particularly those in the Bureau of Entomology, where they have used such a house, and also from the men who have had experience with the insectary, as to whether it is absolutely necessary that we have the insectary, since it is a matter of considerable importance and one which, so far as I know, has not been much discussed in recent years.

MR. BURGESS: Mr. President, since Professor Sanderson has mentioned the breeding outfit at the Gypsy Moth Laboratory, I want to pass around a photograph of the house in which we breed beetles; the one which he has described. This photograph was taken last summer. The house was constructed with the idea of giving natural conditions for rearing predaceous beetles which are being imported from Europe to prey upon the gypsy moth. The canvas top was removed this fall and we now have a large number of beetles in hibernation in the wire cages set in the house.

MR. SLINGERLAND: Mr. President, I was brought up in the first insectary ever built. I have always lived there, and want to continue to do so. It may be that we can do as good work in a cloth insectary, but I want a house that will hold the wind off. I want it for insect photography, for we need more careful details in our photographs. The out-of-door house is all right, and we want that too, but I am still content to live in the first insectary,—the glass house.

MR. WEBSTER: Mr. President, I have been wondering all the time why Professor Sanderson didn't put his question the other way,—"Can you get along without an insectary?" An insectary is a means, and not an end. That is to say, it enables us to get results at short range, that could by no possibility be obtained in any other way. We have field cages scattered nearly all over the country; that is one part of the investigation. Something new appears in the fall, and, with an insectary, it is possible to run it through and get an outline of the history of the insect before spring, when we can take it up in the field and simply use the information got through the aid of the insectary as a guide.

Coming back to the matter of nomenclature again, I want to dis-

tinguish between "breeding" and "rearing." We are doing a great deal of breeding, generation after generation, the offspring of perhaps one pair, and there is no way that we can do that out of doors. You have got to have some place where you can follow the little creatures, almost microscopic, and breed the progeny through the different hosts. We can't follow out matters like parthenogenesis and polyembryony in the field or study a great many of the more minute points under field conditions.

MR. F. L. WASHBURN: Mr. President, it is not right to throw stones when you live in a glass house, but it seems to me that the statement of Professor Sanderson reminds us of the fox and the grapes. He has no insectary, and we have. We have an insectary, and in our cold room the conditions are just the same as outside during winter, fall, and spring. We can control the insect so that we can observe it, which we cannot do if we depend upon outside work.

MR. BRUNER: The persons who have been talking up to this time have spoken entirely on the experimental side of the work. From the standpoint of the teacher, I believe an insectary is indispensable. You have your students in the fall, winter and early spring, when outdoor conditions do not enable them to study the life history of the insect. If you live in the West, you sometimes have insect attacks or outbreaks three, four or five hundred miles away from headquarters, and you must have an opportunity to bring the insects in to study and rear them under observation. The insectary in both of these cases is absolutely necessary.

MR. J. B. SMITH: I do find that when it comes to the question of merely observing the life history of an insect and trying practical methods for its extermination, I can do better in the field than I can indoors or in an insectary. For certain kinds of research work, an insectary, I can conceive, is absolutely indispensable. For mere economic work and for ascertaining means for insect control, I don't think the insectary is necessary. I started out with the idea that I wanted one the worst way, and for five or six years I worked very hard to get one, but I did not succeed, and I finally concluded that I did not want one. I have none at the present time, and I get along just as well without it. On the other hand, I do not do a great deal of the kind of work that requires close attention, and "breeding," as Professor Webster defines it. If I were doing work of that kind, I should feel that it was absolutely necessary.

MR. H. T. FERNALD: Mr. President, I think Professor Smith has, in a way, struck to the root of the matter. Everything depends upon the subject upon which you are at work. I have come to feel the

necessity for an insectary, because such an amount of work in Massachusetts is related to the growing of greenhouse crops. There is a large amount of crop raising under glass in that state, and the insects are particularly abundant on house-raised crops. For such cases as that, insectary conditions are not abnormal, but entirely normal, and, therefore, an insectary or a greenhouse, where you can raise the very crops that are being raised in the forcing houses in the state and apply methods of control to the insects on those crops, is just what you want. If it were out-of-door insects, I should favor the method made use of at the Gypsy Moth Laboratory. I would very much object to doing without a greenhouse under my own control. On the other hand, there are many months, perhaps, in each year, during which I may have no use whatever for that house. It simply amounts to this. When I do not want the insectary greenhouse, I do not want it at all, and when I want it, I must have it.

A. D. Hopkins: Mr. President, Mr. Fernald has just covered part of the remarks I was going to make, that the character of work will determine the kind of insectary. I may say, that in our forest insect work, we have very little use for a glass house insectary. We do need lots of glass, tin cans, tin boxes and paraphernalia of that kind, which are extremely useful in rearing insects from wood and bark.

Mr. Titus: Mr. President, I want to emphasize Professor Bruner's point, and that is in regard to the distance some of us have to travel. Now, I can go from here to Ogden nearly a day quicker than I can go the length of my own state, so that when it comes to a question of handling plants that live in the southern part of Utah, which do not grow in the northern part of the state, we need a greenhouse in order to have these plants growing, so that when the insects come in we will have something to feed them on, as we never could secure them under ordinary out-of-door conditions.

Mr. Jones: Mr. President, I would like to pass around some photographs of the type of breeding house that has been used for the last four or five years by the Bureau of Entomology in rearing deciduous fruit insects. Briefly described, it is a shed with a roof covered with shingles or tar paper and with sides of wire screen, such as is used for fencing chicken yards. The interior is provided with shelves to accommodate jars and breeding cages and in the center is a table for similar use. The floor is made of earth, and in it cylinders and flower pots are placed containing insects which pass a part of their development in the ground. This type of house is used at all of our field stations for miscellaneous breeding work. Special devices often have to be made for investigating special insects.

Mr. Gossard: When I was located at the Florida station, I think we hardly needed an insectary, except large wire cages or something of that description.

I agree that an insectary is, at least, a great convenience at times, and either that or a building of some kind is a necessity. I believe the insectary is useful, but it should not be relied upon too much. In other words, you cannot depend upon results that you get in a greenhouse for out-of-door conclusions. I like, when I am working upon life histories, to have cages in the insectary, because you can isolate your insects, and if they, as they nearly always do, come out a few days earlier, it gives you warning to look for them outside. A great amount of glass I do not think is needful. At the same time, we have a large greenhouse at the Ohio station, and there have been times when I have had it completely filled. Again, it would be vacant for six months at a time.

E. D. Sanderson: Mr. Chairman, I may have misstated this question. It should have been possibly, "Do we need a glass insectary?" There seems to be a difference of opinion on that point. I think Professor Bruner's point about the desirability of a glass insectary for instruction work is a good one, but it seems to me that there is quite a question whether a more open insectary, giving more natural conditions than the glass house, is not better for breeding purposes. As far as parasites are concerned, they are handling as many parasites at Melrose Highlands as any place, and I don't believe that you can get life histories that are worth anything in a glass house when you check them up with what you actually find out of doors. What is the use of making lengthy life history studies which we know do not take place out of doors? We certainly do want a glass insectary for some classes of work, but it does seem to me that we have done a great deal of life history work in glass houses, and if we had checked up carefully, we would have found a good deal of difference between what occurs there and out of doors.

Mr. Slingerland: Mr. President, I must object to some of these points. I don't think my indoor life histories are so very much different from those secured out of doors, and the indoor work gives me experience that helps a good deal out of doors.

Mr. Hinds: Mr. President, the remarks made have been very interesting to me, because we have that question under consideration; that is the establishment of an insectary. I have been very much interested in the plans of Mr. Woodworth, of California, for he is going to have an open court, walled in and a roof to cover a part of the court, so that in rainy weather he can examine the specimens un-

der cover and at other times examine them in the open court. I wonder if it wouldn't be a good thing to compromise and have the glass insectary with the extension, with a sort of an open court partly roofed. Our president has put several thousands of dollars into an insectary, and it might be a good idea to hear his experience.

PRESIDENT FORBES: I must say so far as my observation has gone, it would accord with what has been said by Professor Slingerland. I think if proper ventilation of the insectary is looked out for, and proper screening of glass windows exposed to the sun, and proper temperature records of indoor and out-of-door situations are kept parallel with each other, that there is no reason why indoor results should differ from the out-of-door results. We used to keep within two or three degrees of the out-of-door temperature by having the roof open at the peak and the sides. I don't think it averaged more than a fraction of a degree in the twenty-four hours between the inside and outside. Still, there is a vast amount of work in the ordinary entomological office which I think can be done as well in the cheap temporary construction which has been described, and can possibly be done with more security and less expense. I don't know that I have done more than to sum up this discussion in a general way.

MR. COOLEY: It seems to me that when we publish life histories, we should publish with the life history the temperature records of the room in which the studies were made, in order that others who wish to interpret the results may have the same advantages we have had. In a paper on ticks which I have just submitted for publication, I have given both the temperature and humidity records.

METHODS OF REARING WHITE GRUBS

PRESIDENT FORBES: While we have this subject up, I would like to make an inquiry upon a matter on which I need help. I am doing some difficult breeding work without an insectary, although I have an insectary also. I am attempting, I believe, for the first time anywhere in this country, to carry through an extensive series of breeding operations upon our American species of Lachnosterna. We have five "bug farms," the people call them, in different parts of the State of Illinois, two in southern Illinois, one in the central, and two in the northern part of the state, each of them consisting of a group of forty-eight tile, most of which are two feet in diameter and sunk in the earth to their full depth, except in northern Illinois, where they are sunk in the earth in a double row, and at the bottom of each of these tiles is a layer of either gravel or broken tile. The tile was filled with earth, packed discreetly, and upon this was put a layer of turf, and

the whole was covered with a conical cap, and the various species were deposited beneath that. They were kept there with the hope and expectation that eggs would be deposited from which the larvæ would hatch, and that we would be able to work out the life history of each of these species independently through whatever period might be necessary, and do it in the different parts of the state, so that we should get whatever variations of the life cycle the differences in temperature in our state might involve. But certain difficulties have arisen, and I would like to know if any of you have tried any similar experiments and know whether there is any method of meeting these difficulties. We had an extreme drought during all the latter part of the summer season, and the tiles dried out to the bottom and did not become wet again. The core of earth baked hard and shrank away from the tile on all sides, which exposed it to the sun and allowed it to bake like a solid cake which could be moved about. I have supposed, and it has been suggested to me, that we had "broken the connection," as they say between the soil water and the water in the tile to such an extent that the water which should have risen up in the tile did not do so because of a layer of air in the gravel or broken tile. Now, I would hardly put a question of this kind if we didn't have plenty of time and, in the second place, because it is a piece of work which, so far as I know, no one else is undertaking, unless the United States department may have taken it up this year, and I feel, consequently, that I am undertaking a piece of work that we are all interested in, and if I carry it through, you will not have to do so.

Mr. Washburn: Mr. Chairman, couldn't you use a variety of very fine gauze, wire gauze, for your cylinder, that wouldn't interrupt the moisture?

President Forbes: I have supposed that the wire gauze wouldn't last for the length of time we supposed it would be necessary to maintain this experiment.

Mr. Marlatt: I was going to suggest that a bronze wire might meet the need; such as the best grade of bronze wire now used in houses. I fancy that that would be fairly durable, and, by making a cylinder with it, it might work.

Another idea occurred to me, based on the experience with breeding the Cicada. You remember that half a dozen or more attempts were made to carry the Cicada through, all failing, except the last, on account of the lack of abundance of material. It occurred to me that perhaps that method could be adopted in your work, namely, surrounding a large area, say, several yards, or even a rod, in diameter, with a net, in which you can enclose fifty, or a hundred, or a thou-

sand beetles, if necessary. They would deposit eggs under absolutely natural conditions, and the area would become heavily stocked with the one species.

SECRETARY BURGESS: Mr. President, in attempting to hibernate Calosoma beetles, I had the same difficulty last winter that you have had with the ground drying out inside the cylinders. I used galvanized iron cylinders, two feet in length, and, fortunately, I experimented at the same time with galvanized iron wire cylinders, which worked all right. I doubt, though, if that material would stand for the length of time required in your experiment, but the beetles came through very nicely in wire cages, whereas in a solid galvanized iron cage the soil packed so badly that nearly all of them died.

A MEMBER: Mr. President, may I ask if you used glazed tile?

PRESIDENT FORBES: No; porous tile.

MR. HOPKINS: Perhaps you will find that some of the larvæ will not live as long as has been supposed, and that some of the beetles may emerge a year ahead of others. It had been supposed that the so-called sawyer beetle lived two years before transforming to the adult, but in some observations made by my field men in the South, it was shown they developed from the egg to the adult in three months, and apparently from the same lot of eggs, some larvæ would go over to the next year, and it is possible that some may go over two years, so it is very evident that we need a lot of careful observations on a good many of these things.

MR. SYMONS: Mr. President, I would like to inquire how the gravel, etc., was arranged at the bottom of the tile?

PRESIDENT FORBES: The object in putting material in the bottom of the tile was to prevent an accident which happened sometime before. That is, to prevent the grubs burrowing below the end of the tile and making their escape. We wanted to imprison them, and that is why we put it in. It was a very thin layer, just enough to make sure that the grubs would not go through it.

MR. SYMONS: I thought that by extending that surface of the gravel outside the bottom of the tile the moisture might go up more readily.

A MEMBER: Mr. President, perhaps if you had some method of irrigating the soil, it would work all right. This might be accomplished by putting in two or three tubes.

After the transaction of routine business the session adjourned.

[The above comprises all of the proceedings ready for publication.—ED.]

(To be continued in the next issue.)

THE CALYX CUP MUST BE FILLED*

By A. L. MELANDER, *Pullman, Washington.*

In the June, 1908, issue of this Journal there appeared an article on codling moth spraying, entitled "Filling the Calyx Cup." The style of this article was purposely made assertive and accusing in an effort to arouse Eastern entomologists, by its extreme causticity, to try out in the orchard the treatment which has proved successful in the Pacific Northwest. Copies of this article and Washington Popular Bulletin 5, giving detailed descriptions of codling moth spraying, were circulated among official entomologists and horticulturists. Naturally a radical departure from customary methods stirred up many objections, which have come to us in letters and through the press. A symposium of the objections will certainly interest the student of the codling moth, especially since it is contributed entirely by officials.

The Western method aims simply to place poison beneath the stamens. This can best be done by throwing a driving spray through Bordeaux nozzles, at a pressure approximating 200 pounds. Most of the spraying is done from a raised platform, and a crook is used at the end of the rod to direct the spray downward. The spray must be thrown squarely into every blossom for success. A dilute spray of one pound of arsenate of lead to fifty gallons of water copiously applied is more conducive to thoroughness than is a sparing use of a concentrated wash. One such application destroys the first brood and thus actually insures practically 100% of clean fruit. Thus there is no need for later applications. In addition to assuring thoroughness, high pressure means rapid work, thus reducing the labor-cost. The weak formula saves quite an item. The absence of late generations of worms eliminates disfiguring "stings," which always result when late larvæ have to be destroyed by late surface applications. The single application leaves time for other orchard work after midsummer. Irrigation is not interfered with, as the orchard does not have to be dried out to permit the passage of the spray outfit. There is no damage to apple-laden branches, low hanging because of their weight of fruit, from driving a spray wagon through the closely-planted orchard. Moreover, for oily skinned and glaucous varieties it is the only method that can be successfully used.

A single thorough spraying has afforded practically 100% returns over hundreds and hundreds of acres of Washington orchards. The

*Contribution from the ZOOLOGICAL LABORATORY of the STATE COLLEGE OF WASHINGTON.

same benefit from the single spray has also been abundantly attained in Colorado and Utah. The single spray is obviously the most economical treatment for the codling moth, and as it has proven decidedly the most efficient it deserves the attention of Eastern entomologists. The various objections have therefore been collated and answered, in hopes that the field worker will not be deterred from giving the method a fair practical test.

Finally, I wish to repeat that this article and the one which preceded it were not written to antagonize my fellow-workers. The two were prepared for their benefit, and while the method of arousing attention may lack diplomacy, I hope that the outcome a few years from now will cause an appreciation of the better motives prompting the assertions and accusations to overshadow any present unpleasantness. There will be hundreds of Eastern fruit growers who will follow the Western method of spraying this year, and they will have success. The professional entomologist may as well keep pace, and accept credit for the movement, for the change in the methods of codling moth spraying is bound to come.

1. *"Theoretically the single spray is all that is necessary, provided you have only one variety to deal with, so that all the fruit reaches the same stage at the same time. Our orchards do not equal in extent those of Washington, and we have very few orchards with only a single variety. An apple orchard of three or four hundred trees may contain half a dozen varieties, and the date of blooming between the earliest and the latest may extend for nearly two weeks."*

This published objection comes from a state of one-tenth the area of Washington, yet which contains two-thirds as many trees as we have. In our apple districts the usual ranch comprises from five to ten acres. The orchard of twenty acres is the exception. Moreover, these orchards are planted to just as many varieties as are usually found elsewhere. I know of no orchard set out to one or two varieties exclusively. Although Mr. McInnis, of White Salmon, lost 50% of his crop in 1907, one spraying of his mixed orchard of thirty-five varieties raised his 1908 crop to 99% clean. Mr. Heidenhain of Wenatchee has a house orchard of ten varieties that lost 25% to the codling moth in 1907. This year he sprayed all the trees once, on one day, and changed his returns to a total loss of one-twenty-fifth of one per cent. To get above the trees he used a step ladder. He used a hand pump, one Bordeaux nozzle, and kept the pressure at 150 pounds. Mike Horan of Wenatchee sprayed his twelve varieties but once after personally studying our spraying. He lost 15

boxes to the worms, but his 8,000 boxes of sound fruit were of such condition that a carload selection took the premier prize of $1,000 at the National Apple Show.

Our own college orchard of thirty acres contains six hundred varieties, yet we go over it only twice to insure a thorough first spraying, giving each tree, however, but one application. This orchard was neglected for some years and in 1906 was 40% wormy. Three applications in 1907, two for the first and one for the second brood, changed this mixed orchard to 99.9% clean.

Bulletin 299 of the Geneva, New York, Station lists the blooming periods of 278 varieties of apples for New York. One spraying given about June 1st would answer for an orchard having all these trees.

2. *"Our weather conditions are not nearly so uniform as yours, and on the same tree we may have well set apples and unopened buds. No one spraying will hit all the fruits that are to be protected."*

This objection comes from several localities, both on the Pacific and Atlantic slopes. It is probably universally true that all blossoms on a tree do not mature together. Our spraying is timed for the flowers that will set fruit, and not for the ones that will be thinned off by crowding or picking. The center flowers are always in advance of the others of the cluster, and these are the ones that normally set fruit. Lateral buds do not produce fruit worth the attention of the commercial orchardist, but if it is desired to spray for these there is no objection to "touching up" a tree, as is usually done for scale insects.

3. *"Oviposition is too irregular, both in time and place of egg-laying, to depend on spraying for the calyx alone. Since eighty per cent of the eggs are laid on the leaves I consider the covering of the foliage the most important part of the work."*

A practical answer to this comes from our spraying experiments. In 1907 unsprayed trees used as checks in the orchard were 52% clean. Those trees that were not given the first spraying but which received three subsequent applications produced also 52% of worm-free fruit. Where the first spraying was also given the results were changed to 98%. This season a block of trees was given a single application when the first brood larvæ were just entering the fruit. The worminess was exactly the same as the unsprayed check trees. The adjoining trees that had also a single application, but given a month before, were 99.92% clean. Other similar cases could be cited

to show that although theoretically desirable, spraying the foliage gives no practical benefit.

4. "*Our apples attain a surprisingly large size before the first brood of larva begin to enter the fruit. Thus a large part of the surface will be unprotected by the poison.*"

Coming to Washington with the idea that the second spraying should follow ten days after the first we were surprised to note that the onset of the first brood of worms occurs from a month to seven weeks after blossoming time, and of course by that time Washington apples are also surprisingly large. But that point has little to do with the validity of calyx spraying, for, by the time of the third brood, apples are still larger, yet the first spraying gives just as much protection then as ever. The average of all our counts in unsprayed orchards shows 90% of the late larvæ entering through the calyx. Theoretically, therefore, spraying the calyx alone should destroy 90% of all codling moth larvæ. Practically, however, probably because of the natural mortality of the insect, the number is nearly 100%.

5. "*In every case where the young larva had entered the apple at the calyx end it had stopped to feed in the outer calyx cavity. I was unable to obtain any evidence that the larvæ worked their way into the lower calyx cavity without first taking several meals in the outer cavity.*"

Undoubtedly some larvæ do feed in the outer cavity, but that is not the point. The important fact remains that some larvæ take their first meal in the lowermost cavity, and in the matter of practical spraying our main attention must be directed to them if we are to exterminate the first brood. When poison is forced into the lower calyx cup there is enough in the outer cup and on the leaves to take care of whatever larvæ may choose to feed there. But when a mist-spray is used for the outer cavity alone, some larvæ, a great many even, reach the lower cavity unpoisoned, and then we cannot hope for 100% of success with one—or even more than one—spraying. The western method aims to reach the most inaccessible part of the flower. Only by that method can one spraying be depended on under the adverse conditions prevailing in this three-brooded district.

Director Ball* has already pointed out that "an examination of thousands of apples with this point in view showed that in 97% or 98% of those classed as 'calyx wormy' the entrance had been made from the lower part of the lower cup." Our own observations cor-

*U. S. Bur. Ent. Bul. 67, p. 74.

roborate this statement. It is impossible to believe that the codling moth in the East departs entirely from this habit. The number of larvæ taking their first meal in the lower cavity is probably much less than 97%, but from the large number of dead larvæ found beneath the stamens on sprayed fruit, their diminutive size showing that death occurred during the first instar, it is evident that spraying must be so done as to protect the lowermost cup. We have observed as many as a dozen dead larvæ of the first instar below the stamens of a single apple. The tree from which this fruit came was next to a packing shed where 2,000 boxes of wormy fruit had been culled and dumped, yet that tree, as well as all those near by, was kept 99.9% clean. It is safe to say that such protection could not have been given if the lower cavity had not been reached by the spray. In previous years these trees had been losing three fourths of their crop, though heavily Vermorel-sprayed with concentrated arsenate of lead.

That the larva should be directed to the lower cavity is not strange, for even in our ignorance of the tropisms of the codling moth, we must appreciate that the nectaries are located here, that the epidermis beneath the stamens is much thinner than in the outer cavity, where in the mature fruit it becomes even woody, and that a hiding larva will seek the end of a retreat. Certainly the odor at the calyx end is more intensive, even to our perceptions, than that emanating from the other parts of the apple.

6. "I am informed that at the proper time for the first spraying there is very little rain at Wenatchee to wash off the poison. It is, of course, useless to spray during a rain. A prolonged rainy spell at the first spraying is a serious matter, for it interferes with the timely application of the poison."

Mr. H. E. Bacon has at Evergreen an orchard of thirty-six acres, with about as many varieties. In 1907 this place was sprayed six times with Vermorel nozzles and lost 40% of its crop. This year it was sprayed once under our direction. During a part of the time it rained, yet that had no appreciable effect and the entire orchard yielded over 99% of worm-free fruit.

Almost every year it has rained before the first spraying was completed, in some cases accompanied by a driving wind storm. Nevertheless our spraying has not been interrupted. That there has been no need of waiting for more pleasant weather is apparent at picking time from the results as perfect from the plots sprayed during the rain as elsewhere. In these cases, which have been carefully watched, almost the entire protection to the flower was the poison forced be-

neath the stamens. The outer calyx cup was washed free of spray by the rain, which of course could not penetrate below, like our spray driven at 200 pounds.

7. "I would also call your attention to another point, which perhaps is not familiar to you, and that is, that in some of our varieties it is simply impossible to get the poison down to the bottom of the calyx cup, because of the apple formation itself."

Professor W. S. Thornber, horticulturist at the Washington Experiment Station, has devoted many years to a comparative study of the apple blossom, both in the Atlantic and the Pacific regions, and he assures us that microscopic measurements show no differences in structure induced by the change in environment. We have sprayed nearly one thousand varieties of apples with unquestioned success, and have yet noticed none of such conformation that the lower calyx could not be effectively sprayed.

It is true that the stamens are turgid and woolly and crowd against the pistil, forming a tight barrier against a misty spray, but their diverging free ends make a funnel-throat readily forced open by a pressure-driven coarse spray, if that be squarely directed against the flower, to spring shut again and enclose a drop of the liquid. This probably is the secret why arsenate of lead will serve when used as weak as one pound to eighty gallons, or probably even much less, for the drop carries with it enough poison amply to coat the interior of the cavity when evaporated. Our criterion of thoroughness during the first spraying is to section flowers picked at random to see if the lower cup is filled with liquid. If any flowers are found dry beneath the stamens of course the spraying is imperfect, and 100% returns can not be expected from the single spraying. However, the lower cup is always full when the tower-crook-Bordeaux nozzle, 200-pound pressure method is used.

8. "If I ran the pressure up, the blossoms capsized from the force of the spray, and still the spray did not get into the lower cavity."

A pressure-driven spray directed squarely will invariably be forced past the stamens before the flower has a chance to tip over. Vermorel nozzles, which throw a hollow cone of spray, rarely strike the blossoms squarely, and therefore even if coarse are not capable of filling all the lower cups. When Bordeaux spraying is done from the ground the flowers are hit from the side and are thrown over by the force of the spray without being effectively filled.

9. "Most of our orchardists use too coarse a spray anyway and one

hesitates to advise them to make it any coarser. They will not buy more than one nozzle for all their sprayings and to speak of making that a little coarse would be almost heresy in our state, since they would use this coarse nozzle for all purposes and it would eat up more liquid and would discourage some of them from spraying at all. It does not take much to discourage them anyway during the last two or three years."

A coarse nozzle does not mean a drilled-out Vermorel. It must be of the Bordeaux type, where the force of the liquid is not spent on leaving the orifice. Such a nozzle is not wasteful, but effective. It is the type used almost exclusively in this region, and it is used for all kinds of spraying. It does not miss the object aimed at, like the Vermorel, but shoots a penetrating, effective sheet of spray, filling all the blossoms in its path to a distance of eight or ten feet from the nozzle. Moreover, since the main cost of spraying is labor, a nozzle that throws nearly three gallons per minute is more economical than a battery of Vermorels distributing one half as much spray. A single Bordeaux nozzle is all that a hand-pump can maintain at above 150 pounds pressure. A power sprayer can supply four.

10. "The one point that I take such exception to is the weak spray of one pound of arsenate of lead to fifty gallons of water. In all my experiments I find that less than two and one-half pounds to fifty gallons will not suffice to kill all the worms."

While we use and recommend one pound of the arsenical to every fifty gallons, a block of trees sprayed one pound to eighty gallons yielded us 99.92% of worm-free fruit. These same trees were over 50% wormy the year before when given Vermorel sprayings of three pounds to fifty gallons. It is not the formula that is important, but the method of application.

11. "Fruit trees are being poisoned and killed by excessive use of poisons. The heavy drenching of trees is therefore a dangerous procedure."

The enigmatical disease occurs in Washington, but is prevalent in neglected, little-sprayed orchards as well as in those over-sprayed. But, granting the danger of arsenical poisoning, it is but another point in favor of the single spray. "Drenching the trees" is not a happy description of the western method of spraying. Each blossom is filled or drenched, but the driving spray can be so accurately apportioned that there need be little drip from the tree. To be certain of thoroughness most growers overspray and thus drench the

trees, so that the ground beneath may be damp. In general one gallon of spray suffices for about two bushels of expected fruit. The amount of spray that each blossom can hold is limited, so that with a little watchfulness there need be no waste of spray material. Another point not to be neglected is that our spray contains one pound of arsenate of lead to fifty to eighty gallons, which is about one third the strength usually used. While we may apply more gallons per tree, the total amount of arsenic used is less than when the concentrated misty spray is employed.

12. "Are not the good western results due more to thoroughness than to the 200 pounds of pressure which is supposed to be necessary to drive the spray into the lower calyx cavity?"

A high pressure is first of all conducive to thoroughness. There is little chance of missing blossoms with a broad sweeping stream. In the case of the badly infested Breese-Johnson orchard at Wenatchee, six acres were sprayed at 240 pounds pressure, and two acres at 140 pounds. The six acres lost but one third of one per cent; the portion sprayed at low pressure lost 3%. At 200 pounds pressure practically twice as much spray leaves the nozzle as at 100 pounds. The spraying consumes but one half the time. With western labor at $2.50 per day, and the period of spraying limited to the closing of the sepals, the time element in spraying is an important factor. A coarse spray at 80 or 100 pounds can force the stamens and fill the lower cup, but its effective range is limited and therefore every branch must receive individual attention. A moment's comparison in the field between the western and eastern methods of applying spray has instantly converted every fruit grower to the high efficiency spray. No adequate idea of the effectiveness and rapidity of a downward directed, pressure-driven Bordeaux spraying can be formed by guessing in the office or laboratory.

Washington fruit growers have not been slow to appreciate the economy of power spraying. In 1908 over one hundred fifty high pressure gasoline power outfits were sold in Eastern Washington alone, probably four times as many as were sold in any one state in the Middle West. And yet the ten states between Nebraska, Arkansas and Ohio contain more than one half of all the apple trees grown in the United States, while Eastern Washington has but 1%. In commenting on this fact, Editor J. M. Irvine of the *Fruit Grower* asks: "Is it not likely that this is one reason why our northwestern friends are able to guarantee absolutely every apple in the box, while most of the growers of the Middle West are clamoring for a 'straight pack,'

'orchard run,' and other forms of grading which will take the wormy, scabby apples with the sound fruit?"

13. "Spraying for the first brood alone could not successfully be depended upon in a very wormy orchard, nor where the orchard is surrounded by infested trees."

P. Sanger bought an old orchard at Toppenish that produced 150 boxes of salable fruit in 1907. He sprayed it three times for the first brood in 1908 and packed out 9,000 boxes. The orchard was made 97% clean, a decided change from practically 100% wormy, by careful spraying for the first brood alone. The results should have been practically 100% clean, but a 10% calyx infestation of his wormy fruit indicated a faulty application of the first spraying.

The Breese-Johnson tract at Wenatchee, which lost over half of its fruit in 1907, was certainly a wormy orchard. In 1908 a part of this was sprayed twice and a part once for the first brood and the crop was rendered 99% clean. The second spraying gave no appreciable benefit, not enough to pay for its application, and there were no calyx wormy apples. The Blue Pearmains of this orchard were 90% wormy in 1907, when they had been given four Vermorel sprayings. One Bordeaux spraying in 1908 changed the fruit of these trees to 93% clean. The King apples were 85% wormy in 1907. The one spray of 1908, filling the lower cups, changed the loss to less than 3%.

H. E. Bacon has a 35-acre orchard at Evergreen which lost 40% of its crop when Vermorel sprayed. In 1908 it was sprayed once under our direction and the loss was reduced to less than 1%. Mayor McInnis of White Salmon lost half of his crop of 1907. In 1908 one spraying saved 99%. Doctor Hedger of Kiona lost every pear to the worms in 1907. Then in 1908 he sprayed once and his record was one wormy pear to three hundred boxes.

Such cases could be further enumerated, but these show that spraying for the first brood is not only practical in the badly-infested orchard, but that it is the only method that will succeed.

These same instances will give the answer to the objection made by an eastern entomologist that he would "be afraid to rely on a single spraying during some of the bad seasons, since most of the actual injury in the East here is done by the second brood." That is the very time that emphasis should be placed on spraying for the first brood.

As to the danger from outside infection, we have for some time felt that it is overestimated, when good spraying is done. In a forthcoming bulletin will be given the worminess tree by tree in an orchard ad-

jacent to an unsprayed block of trees. Even those trees next to the unsprayed portion did not become contaminated enough to warrant more than the single spraying they were given.

The Breese-Johnson tract directly adjoins an orchard that was 75% wormy in 1907. The trees adjacent to this wormy orchard are the Kings just cited, which we sprayed once in 1908. The owner of the infested orchard also sprayed and had 25% of loss last season, but the previous and present worminess of his orchard had no appreciable effect on the trees adjoining.

14. "Cannot just as satisfactory results be obtained with Paris green or arsenate of lead applied as a fine mist in moderate quantities over the trees, at about 100 pounds pressure, if the spray is directed down into the open outer calyx cavities? I have not seen sufficient evidence to warrant entomologists in answering this question in the negative."

Z. A. Lanham of Wenatchee sprayed in just this fashion, a power sprayer at 140 pounds, Vermorel nozzles, and three pounds of arsenate of lead to fifty gallons. Even with four applications properly timed his yearly loss was 4,000 boxes, valued at $4,000. We sprayed his orchard, substituting Bordeaux nozzles at the 1:50 formula, and changed his total loss to but six boxes. This man sprayed in the old-fashioned way and paid for it at the rate of $4,000 a year. His spraying bill for labor and materials now amounts to $70 per year. With the slow mist nozzles and concentrated spray and repeated applications it used to be $350.

S. Johnson and L. H. Breese, also of Wenatchee, have an orchard tract that annually lost 60% of its fruit when Vermorel sprayed, even though a power outfit was used. This year Bordeaux nozzles were substituted, two sprayings instead of four were given and the formula was cut down to one third. The total loss for the combined tract of eight acres was one per cent. Here the substitution of Bordeaux nozzles had a money value of $3,000.

A canvass of the orchardists in the Yakima Valley made five years ago showed an average of 85% returns and the Vermorel nozzle was exclusively used. Now these same growers use the Bordeaux nozzle, and their average returns are above 95%. The abandonment of the mist spray nozzle certainly has meant a saving to the fruit growers of Washington of hundreds of thousands of dollars. And, strange to say, scarcely a Bordeaux nozzle is sold east of Colorado.

While such cases as these are extreme instances, taken where the codling moth is three-brooded and consequently capable of much

greater damage than in the North Atlantic States, they suggest however the great potential influence carried by the official entomologist. His advice *is* heeded, and unfortunately the word of the conservative laboratory professor may carry more weight than that of the man who has learned in the field.

Mist sprays seem to give success in the East, but is not their efficiency more apparent than real, due to a comparatively smaller number of larvæ? The same warmth and sunshine that gives a red cheek to our Greening apples also produces an extra brood of codling moth. It is where the codling moth does the greatest damage that the mist spray demonstrates its weak points.

15. *"I do not understand how one spraying can control the insect, when all of our experiments have been conducted in such a way as to make the first spraying just as effectual as we possibly could do, many of our sprayings having been done from a platform and the tree completely drenched, and even with this, usually four sprayings have been necessary."*

This coming from a southern experiment station in one of the most important apple regions may be taken as an answer to the preceding objection. As long as our station used Vermorel nozzles or threw the spray up into the trees we deemed four sprayings necessary for our river valleys. The Idaho station has just tested the number of sprayings necessary when using Vermorel nozzles, and they get their maximum benefit of 94% with five applications. But Vermorel spraying always gives calyx wormy apples, and it is just in proportion to the number of calyx wormy apples that we find the total infestation varying. Five years ago the Yakima orchardists found 40% of their wormy fruit wormy at the calyx. They were then using Vermorel nozzles. When Bordeaux nozzles were substitued and the spraying was done from the ground the calyx infestation was reduced to about 25%. When the crook and raised platform were adopted, absolutely no apples became wormy through the calyx end. Only when calyx infestation is eliminated can one spraying be relied upon.

16. *"Our country is a large one and the differences between the Atlantic and the Pacific coasts are greater than are ordinarily believed, and this applies to plant life as well as to animal life. Because a practice has been found successful in Washington, it does not by any manner of means mean that it will be equally successful on the Atlantic coast."*

It sounds scientific and weighty and learned to assert this, but how

true is it? It was this same excuse that permitted the Pacific coast to have a monopoly of the sulphur lime wash for fifteen years. There are greater differences between the extremes of our Washington orchards where the one spray has been successful than between an average Washington orchard and one in the Atlantic region. The one spray has been used in Washington at elevations from 90 feet to 3,000 feet, with rainfall ranging from six inches to thirty inches, and where the codling moth has two broods as well as where it has three.

An outline of the western method was sent to many horticulturists, practical and official, with the request that it be given a trial. I know of no case east of Colorado where the simple details have been fully carried out. The following tests, however, though given under low pressure, are suggestive.

J. C. M. Johnson of New Wilmington, Pennsylvania, sprayed once only, with a power outfit at 80 to 100 pounds pressure, using arsenate of lead. He writes of his results as follows: "The results were excellent. My Russets, always before wormy, were beautiful and smooth and without a worm, while a small lot of trees in a field that could not be got at had the same old kind of wormy Russets. My Fallowaters showed the same benefit, and the unsprayed ones the same lot of worm holes. The Rambos were equally benefitted. My Baldwins are as near perfection as I ever saw, not a worm. Ben Davis was sprayed with the rest, and has no worms. I consider your advice was worth hundreds of dollars to me."

Mr. P. B. Powell of Clinton, New York, wrote for our spraying directions. He tested the single spray on the only low tree he had, using as much force as he could obtain from his hand pump. The crop of this tree was almost entirely free from worms, while elsewhere, where two less thorough applications were given, his fruit was appreciably injured.

Mr. J. Etna Buck had opportunity to test our suggestions for the Virginia experiment station. One coarse and weak spraying directed downward, at a pressure of 100 to 120 pounds, produced 98.81% of worm-free fruit. Two sprayings gave 98.90%. Obviously if one spraying can be made to produce such results it is not economy to give more. And we are economic entomologists.

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

In accordance with the provisions of the constitution the President has appointed the following Committee on Membership for the year 1909: Dr. H. T. Fernald, chairman, Dr. John B. Smith and Mr. W. D. Hunter.

W. E. BRITTON, *President.*
A. F. BURGESS, *Secretary.*

Scientific Notes

During the summer of 1908, various species of leaf hoppers were abundant in apple and maple plantations in nurseries. *Typhlocyba rosae* L., *Empoasca unicolor* G., and *E. mali* Le B. were common on apples, and *T. rosae*, *T. bifasciata* G. & B. and *E. mali* were also collected on maples. It should be recorded that *E. mali* was present in unusual numbers on beans, and especially on potatoes in all of the leading areas of production. On account of the abundance of this insect, many potato growers were of the opinion that this species was responsible for the early decline of the plants, which, however, was largely due to tip burn, which was widespread and very destructive. The above species were kindly identified by E. P. Van Duzee.

Punctures in bark by *Oecanthus niveus* De Geer are common on neglected apple trees about Geneva. The eggs are deposited singly and may be found in the bark of the limbs and larger branches. The eggs of *O. nigricornis* Walker are laid in linear series, and are usually abundant in raspberry canes.

Polydrosus impressifrons Gyll., an imported species and heretofore not recognized in this country, has been collected in large numbers by Mr. W. J. Schoene on willows, poplars, roses, apples and pears at Geneva and Lyons.

P. J. PARROTT.

Diestrammena marmorata in Colorado. The curious *Diestrammena marmorata* (Haan), an orthopterous insect native of Japan, has just been found in abundance in a greenhouse at Boulder, Colorado. The insect was brought to my notice by Miss Myrtle Fawcett, one of my students, who reports that it is strongly suspected of being responsible for great damage to violets. Some years ago, the same species was found in a greenhouse at Minneapolis, and on this account was figured in Lugger's work on the Orthoptera of Minnesota, p. 254. Other species of the genus are well figured by Rehn in Proc. Acad. Nat. Sci. Phila., 1906, p. 288 and 291.

T. D. A. COCKERELL.

Locust control in South America. Clippings from Montevideo papers, kindly placed at our disposal by Dr. Howard, notice a recent law in relation to locust outbreaks. There is a central committee appointed by the executive. This committee is charged with the execution of the law and is empowered to appoint departmental, sectional and district committees. The law makes it obligatory for proprietors and tenants of lands invaded by lo-

custs, to combat and destroy, at their own expense, both the flying insects and the nymphs, and to notify the authorities promptly of the date and place of oviposition. The editor of the *Montevideo Times* objects to this feature of the law, claiming that the burden on certain landlords and tenants would prove ruinous, even if the locusts did not devastate the affected section. Provision is made for the protection of certain birds. Violators of the Act are liable to fines ranging from $10 to $500. The proceeds from fines and an appropriation of $100,000 are made available for the prosecution of this work. The editor of the *Times* very wisely calls attention to the fact that this Act should be supplemented by the creation of a permanent office for the study of locusts and, in particular, for devising means for controlling these pests. There is certainly need of economic work in that section of the world.

Brown-tail moth, *Euproctis chrysorrhœa* Linn. Nurserymen and fruit growers have been considerably aroused over the reception of large numbers of seedlings from Angiers, France, bearing many nests of the brown-tail moth. These shipments were widely distributed in New York state and also sent to other parts of the country, New Jersey, Tennessee, Iowa and Missouri, at least, having been the destination of such packages. The New York State Department of Agriculture, through its inspection force, has displayed a most creditable activity in locating shipments and in insisting upon the observance of rigid precautions to prevent this insect from becoming generally established. All nests are removed from the stock and burned, all infested stock and that in boxes where nests are found, is dipped in a miscible oil diluted with 20 parts of water, and the packing and boxes destroyed by burning. A most interesting feature is the great resistance of these hibernating caterpillars. There have been a number of records of free caterpillars, that is, those not protected by nests, surviving fumigation under ordinary conditions with the usual amounts of cyanide of potassium, namely, one ounce to 100 cubic feet of space, for two hours and even for a longer period. The establishment of this pest in widely separated localities can be prevented only by the heartiest coöperation of all importers in adopting the most stringent measures for the destruction of the caterpillars.

This not altogether unexpected introduction is a very strong argument in favor of an adequate national quarantine on our eastern coast at least. The amount annually expended in New England for control of the Gypsy and Brown-tail Moths, insects which might have been easily excluded, would support such an undertaking for at least a decade.

E. P. FELT.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

FEBRUARY, 1909

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints of contributions may be obtained at cost. Minor line figures will be reproduced without charge, but the engraving of larger illustrations must be borne by contributors or the electrotypes supplied. The receipt of all papers will be acknowledged.—EDS.

The Baltimore meeting was a most profitable and interesting gathering. Our frontispiece shows that there was a large assemblage, including a number of veterans and most of the active entomologists of the country. There was an unrivaled opportunity to come into close touch with the latest developments in economic entomology. The program departed greatly from that of many earlier sessions. A considerable portion of the time was devoted to very profitable discussions of methods. The extended paper containing numerous detailed observations of limited general interest was conspicuous by its absence. Those who recall the tense strain necessitated by the heavily overloaded program at our last meeting in New York, most surely welcome the change. We believe that a large part of this relief is due to the possession of a publication in which longer papers can be submitted to a critical audience in much better shape than when delivered orally. Many entomologists are taking advantage of the better publication facilities and it is to be hoped that this tendency will continue, and that our meetings may be devoted more largely to the ascertaining of facts not ordinarily published, rather than to the recital of extended records belonging more properly to the printed page.

There is such a thing as over-organization. The economic entomologists, nursery inspectors, the Entomological Society of America, Section F of the American Association, and the general zoölogical organizations all have something of interest for the economic entomologist. Then, in addition, there were the affairs of the Journal Publishing Company and various other minor organizations. It was extremely difficult to meet the demands of all and at the same time have a certain measure of leisure for discussion of problems with those working along similar lines. It would seem as though coöperation might result in the more economical handling of much of the business and

something be gained by the consolidation of a few allied organizations. One side of this problem was considered in the tentative discussion regarding the possibility of the economic entomologists affiliating with other organizations engaged in agricultural research. While this larger affiliation may be advisable, we believe that something must be done shortly to still further simplify the requirements of our annual meetings.

The following statements are by the Business Manager: Volume 1 of the JOURNAL OF ECONOMIC ENTOMOLOGY has now been successfully completed and it may interest our readers to know something of the present status of the Journal. We now have 485 paid subscribers in every state and territory except North Dakota and Wyoming, in all of the Canadian provinces and in thirty-eight foreign countries, there being eighty foreign subscribers. Six hundred copies of every issue have been circulated as guaranteed to our advertisers. The first year closed with a small balance, providing that all bills payable are collected. The actual printing of the Journal costs about $1,000. The publication of the Journal would be entirely impossible were it not for the support which we have received from advertisers, which has been due to the very efficient work of Prof. Wilmon Newell, state entomologist of Louisiana. During the past year about $500 worth of advertising was secured by Mr. Newell.

At the meeting of the Publishing Committee, it was voted that a most cordial vote of thanks be extended to Professor Newell for the great service that he has done the Journal and those interested in it.

There can be no question that the Journal is an excellent advertising medium for reaching the economic entomologists of the world. The returns from such advertising are, however, not as directly traceable as in the case of most advertising mediums, and we would urge our readers to show their appreciation of our advertisers by carefully reading the advertising pages and mentioning this Journal when doing business with our advertisers.

At the meeting of the Journal Publishing Company, it was decided to furnish Volume 1 to all new subscribers for $2 until our supply is reduced to 100 sets, after which the price will be raised and a certain number will be kept permanently for furnishing sets to libraries. As there are about 200 sets of Volume 1 now on hand, this means that the next 100 subscribers can secure Volume 1 at $2, after which the price will be advanced and without doubt Volume 1 will be difficult to secure before many years. If you have friends who are prospective subscribers, you will do them a favor by advising them of this fact.

Bills for Volume 2 will be mailed to all subscribers of Volume 1 and subscribers' names will be carried on our list until April 1. If remittances or orders to continue the Journal have not been received by that time, the names will be dropped from the mailing list, which is necessitated by the rulings of the post-office department. This explanation is made so that subscribers may advise us of their wishes as to the continuance of subscriptions.

There are many public libraries subscribing to some entomological journals, which should have this Journal. Those of our readers who can aid the business manager by suggesting names of such or by calling the attention of librarians to the Journal will confer a favor upon the management.

Obituary

FRANCIS HUNTINGTON SNOW

The recent death of Dr. Francis H. Snow removes from the ranks of American entomologists a medalled veteran of the service. It was in the '60s that Francis Snow, a boy of twenty-five, went out to Kansas from Massachusetts as professor of mathematics and natural science in the just-established state university at Lawrence. He was one of the three men who formed the entire first faculty of the embryo institution. The other two finished their work years ago, but Dr. Snow's call to rest was delayed until he was able to see a wonderful fruition of his labors.

With the addition of new men to the faculty Professor Snow was able from 1870 on to restrict his work to natural history and after 1886 to botany and entomology, his chief interest and activity from the first having been devoted to the collection and study of insects. In 1889 in response to the wish of all the people of the state, excepting himself, he was called to take the presidency of the university. This heavy load of administrative duty he simply added to his other work because he would not be driven out of his laboratory and museum. The university began under his administration that rapid growth which it has continued up to today. The double burden was successfuly sustained by him for eleven or twelve years, but at the end of that time, warned by symptoms of bodily rebellion, among which serious insomnia was a conspicuous one, Chancellor Snow gave back to the Board of Regents his charge of the university and devoted himself entirely again to the care and further increase of his great collections. It was as active director of the natural history

museum and emeritus professor of natural history that he died on September 20, 1908, aged sixty-eight years.

There is no space here to enumerate ever so compactly or fleetingly the special activities and successes of Professor Snow's career. He was the pioneer naturalist of Kansas, and for thirty years its most conspicuous representative in meteorology, botany, ornithology and entomology. Distinctly an old-time "naturalist," student of Nature in the field as contrasted with the newer type of laboratory "biologist," Professor Snow was at the same time a teacher and personal help and inspiration to students of a type only too rarely known in university circles. His love of birds and flowers and insects never obscured or overcame his love of his students. His enthusiasm and energy were contagious. He made first-class men out of the best of us, and something at least worth while out of the worst of us. The roll of "formerly of Kansas" men who are teaching and investigating in lines of natural history is a long one, and the list of Snow's students is a large part of it.

Dr. Snow's personal contributions to science are chiefly systematic, faunistic and economic. The gathering together and care of the remarkably large and rich collections of the University of Kansas are not to be reckoned as the least of these contributions. For though the effective aid of Dyche, Williston and others has been an indispensable part of the building up of these really notable collections, Snow was through it all a guiding, driving and inspiring spirit. For many years his was the sole activity. These collections now housed in a splendid special museum building are an abiding tangible evidence of Dr. Snow's capacity and enthusiasm.

The most conspicuous period of Professor Snow's entomological career was that of the early '90s when, under his control, Kansas tried on a large scale, with special appropriations from the Legislature, the artificial introduction of epidemic diseases among the chinch-bugs of her great wheat and corn fields. Our laboratories and offices were overrun by the hundreds of thousands of little black and white malodorous pests which were being sent in and out by daily scores of mail packages. The work and its results have been variously judged. We may admit at once certain mistakes in interpretation of results and certain failures in method. But all these concessions to just criticism do not cancel the positive results of benefit which certainly came through the wholesale spreading of fungous diseases that would otherwise have remained much more restricted in their range and effectiveness. With these immediate positive benefits, too, came the more indirect but perhaps larger one of the awakened in-

terest of the people in scientific insect-fighting, and the aroused attention of entomologists to the possibilities of this phase of economic work.

The rewards of honor that came to Professor Snow in his long, active life of student, teacher, university president and representative citizen need hardly be mentioned. From Williams College, his alma mater, he received an honorary Ph. D. in 1881, and from Princeton University the degree of LL. D. in 1890. His conspicuous part in encouraging local interest in natural history was recognized by his election five times as president of the Kansas Academy of Science. His personal acquaintanceship among the people of the state was extraordinarily large, and his place in the respect and affection of these people was evinced time and time again by public recognition of one kind and another. In the days of the Populist control of the state administration, it is probable that it was only Snow's personal strength with the people that saved the university from such serious interference as befell the State Agricultural College. The dedication of the beautiful university building of natural history as Snow Hall, and the building, by special legislative action and appropriation, of a residence for his inhabitancy for life, were characteristic recognitions of his value to the university and the state.

But I must not give my pen more rein. My personal feelings I have given no rein at all. As student, assistant, colleague and intimate friend of Francis H. Snow for twenty-five years, I have in my mind and heart such a wealth of dear memory that I do not trust myself even a word or phrase of personal appreciation. If I should, it would be too extravagant for publicity, to insufficient for my own satisfaction.

VERNON L. KELLOGG.

PARIS, December 24, 1908.

Reviews

Manual of North American Diptera, by SAMUEL W. WILLISTON, p. 1–405, 161 figures. 1908. James T. Hathaway, New Haven.

The Diptera, or two-winged flies, are rapidly coming to the front on account of numerous forms previously almost ignored and now recognized as of great economic importance. The author has laid a heavy obligation on all entomologists in turning aside from other lines of work, to condense into this useful manual the experience of a lifetime. The value of the publication has been greatly increased by the coöperation of such Dipterists as Aldrich, Coquillett, Townsend and others. The large series of illustrations

gathered from the best available sources or specially prepared for the work, constitute a most helpful addition for the amateur. We regret that the author has not seen fit to include in this edition a bibliography of the more important works. Despite some minor imperfections, this manual must remain for some years at least, the standard work on Diptera, invaluable to the amateur, indispensable to the specialist and most illuminating to the general student of entomology.

James Fletcher, LL.D. Ottawa Naturalist, January, 1909, p. 189–234.

This memorial number will appeal most strongly to American entomologists. The major portion of the number is occupied by papers and testimonials given at a memorial meeting held December 1, 1908, Dr. Saunders, Mr. Harrington and Professor Macoun being some of the more widely known participants. There are many delightful references to incidents in the life of Dr. Fletcher, showing his great love for Nature, his unselfishness and, most striking of all, his ability to leave a wholesome impression upon all with whom he came in contact. Messrs. Gibson and Groh contribute a list of the published writings of Dr. Fletcher. This memorial number is a striking tribute to the large place Dr. Fletcher filled in the hearts of his friends. A life worthy of such a testimonial commands the admiration of all. The editor is to be congratulated on the general excellence of this issue.

Twelfth Report of the State Entomologist of Minnesota, by F. L. Washburn, p. 1–205, 1908.

This report contains valuable additions to our knowledge respecting a number of important insects. There is an extended discussion, illustrated by an excellent colored plate, of the apple leaf hopper, special attention being given to repressive measures. Grasshopper control is briefly noticed. Original biological data on the green aphis, *Toxoptera graminum*, the English grain louse, *Macrosiphum granaria* and other species are placed on record and control measures discussed. The report contains a record of the nursery inspection work, including a summary of the laws in force in other states. There is a general discussion of spraying, with notes on a number of injurious species, and special notice of some important shade tree pests. There are extensive records of experimental work with insecticides against the cabbage maggot. An unusual feature is found in the series of abstracts of entomological papers from the Experiment Station Record. Mr. R. A. Vickery is the author of an excellent paper on the anatomy of plant-lice. Mr. Brues describes a number of new parasites of the cabbage maggot, while Doctor Franklin characterizes the larvæ and pupæ of certain stalk borers. The report contains an excellent series of original illustrations.

Tick Eradication, by E. C. Cotton, Tenn. Agric. Exp't. Sta. Bul. 81, p. 53–71, 1908.

This comprehensive discussion of the cattle species is based upon two years investigations under Tennessee conditions. The life history of the tick is discussed in detail, the changes in the cycle being illustrated by a series of figures and diagrams. Pasture rotation and its applicability to common farm

practice is carefully discussed and the results obtained in Texas are described. There is also a comparison of the life histories and habits of the North American fever tick and the dog tick, in particular.

The Leaf Hoppers of the Sugar Beet, by E. D. BALL, U. S. Dep't. of Agric., Bur. of Ent., Bul. 66, Prt. 4, p. 33–52, 1909.

Doctor Ball's familiarity with this group enables him to discuss these species in an authoritative manner. The bulletin gives in detail the distribution and life history records of several species and discusses their relationship to the "curly-leaf" condition frequently found on sugar beets. Doctor Ball suggests several measures for the control of *Eutettix tenella* Baker, the species responsible for much of the injury. The bulletin is illustrated by an excellent series of plates.

A Brief Survey of Hawaiian Bee Keeping, by E. F. PHILLIPS, U. S. Dep't. of Agric., Bur. of Ent., Bul. 75, Prt. 5, p. 43–58, 1909.

This bulletin discusses in a summary manner the status of bee keeping in the Hawaiian Islands and gives a list of the honey-producing plants of that section. The value of the bulletin is greatly enhanced by a series of admirable plates.

Part 6, p. 59–80, of the above-cited bulletin discusses the status of apiculture in the United States and gives extensive tabular data showing the extent of this industry.

Control of Leaf Blister Mite in Apple Orchards, by P. J. PARROTT, N. Y. Agric. Exp't. Sta. Bul. 306, p. 417–38, 1908.

The author records extensive injuries by this pest and advises an early spring application of a lime-sulphur wash or a miscible oil. The recommendations are supported by experimental data obtained in various localities.

The Grape Leaf Skeletonizer, by P. R. JONES, U. S. Dep't. of Agric., Bur. of Ent., Bul. 68, Prt. 8, p. 77–90, 1909.

This is an extended biological account, illustrated by numerous original figures, of *Harrisaña americana Guer.-Men.*, accompanied by an extended bibliography. The author advises hand-picking or the employment of arsenical poisons.
E. P. FELT.

A Revision of the Ixodoides, or Ticks, of the United States, by NATHAN BANKS, U. S. Dept. of Agric., Bulletin Bureau of Entomology, Techn. series No. 15, 1908.

This is a valuable and thorough contribution to this little known group, which is of recognized economic importance. Keys are given for the families, genera and species, each species being fully described, five proving to be new. There are ten full-page plates. Chapters are also given on structure, life-history, geographical distribution, abundance, historical and classification, and there is a synomical list of the North American ticks, together with a full bibliography. Very little systematic work has been done on this group and there is an excellent field for investigation.—KARL R. COOLIDGE.

The House Mosquito, by J. B. Smith, N. J. Agric. Exp't. Sta. Bul. 206, p. 1–21, 1908.

This is an extended and thoroughly practical discussion of a very common species. Professor Smith has had exceptional opportunities of studying this and allied forms.

E. P. Felt.

Current Notes

Conducted by the Associate Editor

Mr. J. L. Randall is now engaged in teaching at the Pennsylvania State Normal School at California, Pa.

About May 15, the Hawaiian Board of Agriculture and Forestry expects to appoint an assistant entomologist. A man is desired who can take up work on Coleoptera or parasitic Hymenoptera as a specialty, and who has had some experience in laboratory and field work. The salary will range from $1,500 to $1,800 per annum, depending on the man. Correspondence can now be opened. Applicants should state their age, school attended, experience and give references. Address, Jacob Kotinsky, Superintendent of Entomology, Board of Agriculture and Forestry, Honolulu, Hawaii.

Mr. F. W. Lowe, until recently employed at the Gypsy Moth Laboratory in Massachusetts, has been appointed an assistant in the Bureau of Entomology.

Mr. Harry S. Smith, who has been engaged in investigating the parasites of the Cotton Boll Weevil, has been transferred to the Gypsy Moth Laboratory at Melrose Highlands, Mass.

Mr. Eugene W. Wall has been appointed an assistant preparator in the Bureau of Entomology.

Mr. H. L. Viereck has been appointed an assistant in the Bureau of Entomology. He will work principally on the parasitic Hymenoptera.

Prof. Braxton H. Guilbeau, professor of zoölogy and entomology at the Louisiana State University, and director of the Gulf Biologic Station at Cameron, La., committed suicide on Saturday, January 16, by shooting himself through the head. He leaves a wife and two young children. Overwork is said to be the cause of the calamity, Professor Guilbeau probably having become temporarily deranged.

Dr. S. A. Forbes, we note in the columns of *Science*, has resigned from the chair of zoölogy in the University of Illinois, the resignation to take effect September 1st. Dr. Forbes will continue to serve as State Entomologist and Director of the State Laboratory of Natural History.

Mailed February 15, 1909.

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Proceedings of the Twenty-first Annual Meeting of the American Association of Economic Entomologists

(*Continued from February number*)

Morning Session, Tuesday, December 29, 1908

The meeting was called to order by First Vice-President Britton at 10.10 a. m.

CHAIRMAN BRITTON: The meeting will please come to order. The first number on the program will be two papers by Mr. J. G. Sanders.

(Abstracts of these papers were presented.[1])

NOTES ON INSECT PHOTOGRAPHY AND PHOTOMICROGRAPHY

By J. G. SANDERS, *Washington, D. C.*

In response to the requests of several entomologists interested in photography of insects, a few notes on this subject are herewith offered. Limited space precludes a full discussion of this interesting work, but a few helpful suggestions may minimize the bugaboo of intricacy which deters many from attempting the work and hinders others in attaining good results.

The desirability of good photographs of insects is becoming more apparent as our critical study of those creatures advances. In this

[1]The first paper, entitled "The Identity and Synonymy of a Few of Our Common Soft Scales (Coccidæ), will be published in the next issue of the JOURNAL.

neglected phase of entomological work great things are in store for the careful operator, and surprising results can be obtained with good lenses properly selected for the work at hand. A certain life-like and characteristic reproduction of general appearance and of minute surface detail that can not be duplicated by pen or brush, is obtainable by means of the photographic plate. On the other hand, portions of insect anatomy can be portrayed more satisfactorily by a line drawing which defines and accentuates outlines.

Since the ordinary photograph is composed entirely of light and shade and intermediate tones, it is necessary to study the subject with a view to the best illumination to produce the contrasts and high lights necessary for good detail. Photography of insects and of landscapes are radically different; in the former greatest detail, in the latter a certain indistinct haziness is considered the optimum result.

It is evident that photographs of insects, to be of benefit for illustration and study, must range from natural size to several or many diameter enlargements. By general consent, a photograph of an object from natural size up to ten diameters is called a *photomacrograph;* beyond ten diameters, a *photomicrograph.* There may be some value in this distinction, but the general idea of a photomicrograph is an enlargement of one hundred or more diameters. Photomicrography will be discussed under a separate heading.

Insect Photography

A perfect, well mounted, clean specimen is absolutely essential for a good photograph, since every defect is extremely noticeable at an enlargement of several diameters. Flat and convex insects can be photographed satisfactorily, but must receive different treament to insure that all parts may be in sharp focus.

There will be little excuse for poorly focused pictures of convex objects when it is understood that by "stopping down" the lens (reducing the diaphragm orifice) proportionately greater depth of focus can be obtained. It must be remembered that stopping down the lens reduces the amount of light reaching the sensitive plate, thus requiring much longer exposure.

Apparatus.—It is presumed that the operator has the ordinary dark-room facilities available, and has a general idea of the principles of photography.

An ordinary long bellows camera may be fitted up for temporary use by a handy person. It may be arranged horizontally or vertically, preferably the latter, because of the ease in arrangement of specimens, either dry or immersed in liquid, and the greater facilities of

illumination and arrangement of background. For a large amount of work it is preferable to obtain a photomicrographic stand. The Bausch & Lomb Optical Company, of Rochester, N. Y., has produced one of the best simple stands available for this work. This stand is adjustable for inclination to any angle from horizontal to vertical, and is provided with a 24 inch bellows, with adjustable lens board and ground glass, and carries 4 x 5 inch plates.

There are numerous lenses on the market which may be available for enlarging work. The Bausch & Lomb firm has produced in their Micro-Tessar series the best lenses for this work that are known to the writer. The 72 mm. lens (nearly 3 inch focus), which is extremely rapid, working at f-3.5, is the most serviceable one for ordinary work. With the above photomicrographic stand and 72 mm. lens, photographs ranging from one-half natural size to 8 diameter enlargements can be secured. The 48 mm. and 32 mm. lenses are of higher power. With the latter lens fitted in the above stand 20 diameter enlargements can be made.

The ordinary dissecting stand, with rack and pinion, will be found very useful for focusing. A piece of plain glass to which has been glued a cork fitting the lens holder of the dissecting microscope, can be used for carrying the specimens. When the bellows has been adjusted at the proper length to secure the desired magnification, the focusing can be done with the above arrangement without further change of the bellows.

Preparation of subject.—As before stated, the specimens may be dry or immersed in a watch glass or shallow glass dish, the latter method being applicable to larvæ or specimens in preservative fluids. The fluid has a buoyant effect on the hairs or spines of various hairy larvæ, causing them to assume a more natural appearance while immersed. To prevent shadows, loose specimens should be laid upon a very clear, clean glass as above mentioned, with the background some distance below. For pinned specimens a tiny piece of cork should be glued to the glass plate, thus preventing any shadow from specimen or pin. An old photographic plate, cleared of the film with sulphuric acid, will furnish a good grade of glass for this purpose.

Whenever possible the pins should be removed from the specimens to be photographed. Where this is not advisable, the head of the pin should be cut off and the cut end blackened with India ink. The pin can be almost eliminated in a photograph if its axis is arranged to coincide with the axis of vision. Specimens to be photographed should be cleaned of any particles of dust or lint by means of a small camel's hair brush.

Illumination.—Various radiants may be used for illuminating the object to be photographed, namely,—sun, calcium, electric, gas, or kerosene light, named in the order of their actinic power. In using daylight, north or east light is preferable for photographic work of this kind. Specimens photographed in direct sunlight frequently cause reflections and halation on the sensitive plate, and hence it is not so satisfactory as a more subdued constant light. To secure even illumination on all sides of an object where the light is admitted at but one side of the room, the entire apparatus may be suspended so that it may be revolved during the exposure of the plate. Special light may be thrown upon any portion or all of an object by means of a concave mirror such as is provided with the ordinary compound microscope; or a paraboloid lens may be used to concentrate the light. A softer light reflected from a half cylinder of white paper is often more desirable.

Background.—Faulty and imperfect backgrounds ruin the appearance of more amateur pictures than any other of the minor defects. If the glass plate mentioned above is always used, with the background either white or black, at some distance below, perfect negatives without shadows may be secured. The best black background can be made by lining a deep box with black velvet, or dull black paper such as is used in packing photographic plates. Covers to the box with orifices of various sizes to suit the specimens add to the intense blackness of its interior. In case a black background is used great care in arranging the specimens on the glass plate is necessary to prevent accumulation of bits of dust or lint. Such particles of dust or lint are strongly reproduced on the black background, though scarcely visible on a white background.

Plates.—Any of the standard plates are good for this work, but special brands are preferred by some. Seed's Gilt Edge No. 27, a very rapid plate costing a few cents more per dozen than others, has given complete satisfaction. A slow plate may be preferable in many cases, but where time is a factor a fast plate is a time saver, especially in photomicrography, where exposures of several minutes are often necessary. Orthochromatic, color corrected and non-halation double coated plates often give better results than the ordinary single coated plates. It should be remembered that one-half strength developer should be used on double coated plates.

Developer.—A most satisfactory single solution non-staining plate and film developer which will keep indefinitely in stoppered bottles, and may also be used for developing Velox and kindred papers, can

be made in any quantity, using the following proportions, by thoroughly dissolving in water in the order given.

1 oz. Metol.
2 oz. Hydrochinon.
16 oz. Sulphite of Soda.
14 oz. Carbonate of Soda.
60 grains Potassium Bromide.
320 oz. Water (distilled or boiled).

Directions for use.—For Velox and kindred papers, full strength; for ordinary plates, stock solution 1 part, water 1 part; for films and double coated plates, stock solution 1 part, water 2 parts.

Operations.—One of the most important operations of photography is the proper focusing of the image on the ground glass. At high magnification the image is so obscure that it is often necessary to use a focusing glass. A focusing glass may be purchased, or it is comparatively simple to make one from an ordinary dissecting lens mounted in a cylinder of proper length, according to the focal distance of the lens. This focusing lens is placed on the ground glass and enables one to secure much greater exactness than is possible with the naked eye. After the object is properly focused on the surface nearest to the camera, by stopping down the lens it will be seen that the depth of focus is increased wonderfully as the diaphragm orifice is reduced, thus bringing all parts of the convex insect into sharp focus. If the lens is focused on the portion of the insect farthest from the camera, stopping down the lens will not bring the nearer portions into sharp focus, as objects beyond the original point in focus only, are brought into sharp focus by stopping down the lens. It must be remembered that in judging the time of exposure the stop at which the lens is placed and the bellows length all contribute to variation in the time. As one enlarges from natural size, each full diameter enlargement requires double the amount of exposure required at the previous enlargement. With the stopping of the lens the time of exposure is almost squared.

It is often desirable to make two or three, or even four, exposures of an insect from different points of view on the same plate, such as dorsal, lateral, ventral views, etc. This seems at first a rather difficult proposition, but by the use of two diaphragms, each covering one-half of the photographic plate, dividing the surface in half lengthwise and crosswise, any four separate exposures may be made on the same plate by simply shifting these half diaphragms. These diaphragms may be made of black cardboard, or better still, of hard rubber plates, such as are used in an ordinary plate holder. These

can be cut to fit in the end of the bellows nearest to the plate, but never to be used in the plate holder.

In case one is using the ordinary photomicrographic stand it is very convenient, by means of two millimeter rules, to ascertain and mark upon a stick just the exact bellows length required for various enlargements for the various lenses at hand. In this way much time will be saved, since the length of bellows for any desired enlargement can be readily determined.

Photomicrography

The same photomicrographic stand mentioned above is available for this work, but no special lenses excepting those furnished with the compound microscope are absolutely necessary. The objectives and oculars furnished with the microscopes of years ago were not properly corrected for photomicrographic work, but very good work can be done with the lenses of very recent years without purchasing special photomicrographic lenses. The object to be photographed should first be focused through the microscope in the ordinary manner, and the lower diaphragm should be stopped down to the light which is best for ordinary examination of the specimen. The microscope is then placed beneath the bellows and the hood attached to the tube, and by shortening or lengthening the bellows, the image can be arranged at the proper size on the ground glass. The amount of light passing through the high power lenses is so slight that a focusing glass is absolutely necessary to see the image. It is frequently necessary to refocus the microscope so as to bring the object into sharp outline on the ground glass. Then by stopping down the lower diaphragm slightly and reducing the light, a greater depth of focus can be obtained, although requiring much longer exposure to obtain a good negative. In order to obtain the greatest depth of focus possible, it is advisable to use the lowest power objective which is suitable, and a long bellows rather than a short bellows and a high power objective for the same picture.

Better results can frequently be obtained by the use of stained specimens. The stain should be one of the colors which will reproduce in black on the sensitive plate, the red tints being preferable. The plate which has been exposed for a photomicrograph should be developed rather slowly and carried to the limit, being careful lest in overdeveloping detail may be lost.

A MEMBER: I wish to ask how you avoid reflections in alcoholic specimens from the blacks.

MR. SANDERS: I use a double coated non-halation plate. This larva which I have photographed was in a shallow glass dish with no glass between it and the lens.

A MEMBER: What is your enlarging apparatus?

MR. SANDERS: Any ordinary camera lens can be used. The bromide paper is an exceedingly fast paper, faster than Velox, perhaps a hundred times, but is printed and handled in the same way.

MR. PARROTT: What paper do you use?

MR. SANDERS: I have forgotten the name of the brand but any bromide paper is satisfactory.

CHAIRMAN BRITTON: The next paper on our program is "Photomicrography of the Diaspinæ," by Mr. R. A. Cooley.

An abstract of the paper was given at the meeting, the paper in full follows:

PHOTOMICROGRAPHY OF THE DIASPINAE

By R. A. COOLEY, *Bozeman, Montana.*

In these days when economic entomologists are frequently called upon to make scattering identifications in widely differing groups, it is desirable that systematic papers be written in unmistakable language and that the illustrations be such as to leave as little doubt as possible. The economic entomologist considers systematic work to be a means to his end and believes that systematic papers should be as generally usable as possible. The advantage of photographs over drawings in illustrating entomological publications is well recognized, though pen drawings of detail still and always will have a place.

Any one who has attempted to make pen drawings of the terminal segments of the Diaspinæ is aware of the difficulty of securing anything like a pictorial effect or even reliably representing the original. It has been found that good negatives can be made of these insects, particularly when the microscopical mounts are made with this purpose in mind. The following remarks, which are largely based on our experience in preparing a series of photographs of the genus *Phenacaspis,* will apply in many respects to the photomicrography of other similar objects.

Preparing the Mount.—The writer formerly employed glycerine jelly as a mounting medium for scale insects on account of the greater difference between the refracting qualities of the nearly transparent chitinous parts of the terminal segments and the glycerine jelly than exists between the chitin and balsam. The glycerine jelly mounts

were sealed with a ring of cementing substance like white zinc cement or gold size, but it was found that mounts that had been made a few years were badly damaged through the evaporation of the water in the glycerine jelly. It was necessary to remount all specimens preserved in this way. Canada balsam is now used and it is found that by attention to some details sufficient contrast can be secured.

Specimens to be photographed should be cleared and "posed" with unusual care, all foreign material, as dust and disintegrated tissues from within the body, being carefully excluded. The writer clears specimens by boiling in caustic potash solution in a small, shallow, porcelain dish, replacing from time to time, with a finger-bulb pipette, the water that boils away. The cleared specimen is taken up with a pipette and dropped into filtered water in a clean vessel. From the water it is passed through two or three graded alcohols which leave the empty body wall in an expanded condition. For the best results it is sometimes desirable to pass the specimen through two or three graded alcohol-clove oil mixtures. The specimen is taken up in a drop of the clove oil and placed on the slide and as much as possible of the oil is removed with small strips of bibulous paper. Care must be taken at this point not to introduce dust or threads from the paper. A small quantity of thin, filtered xylol-balsam is added and a number two, half-inch, circular cover-glass is applied. Exceptional care should be taken to secure a thin mount, thus making it easier to bring all parts of both the ventral and dorsal surfaces into focus under high magnification.

The Set Up.—Our first negatives were made with a home-made device consisting of a slotted board fastened in a vertical position to a low platform on which the microscope was placed. An extra lens-board in the front of the camera to which was attached a light-proof sleeve which dropped over the barrel of the microscope was found to be effective in making a light-proof connection between the camera and the microscope. This sleeve allowed sufficient play for focusing the microscope. Such a set-up can be secured with very little cost and if vibration is prevented as good negatives can be obtained as with a more expensive equipment. For convenience the writer now uses a heavy iron stand made by the Bausch & Lomb Optical Company which has two parellel guide rods with a scale on one for recording the degree of extension of the bellows. Our stand has extra long guide rods, made to our order for use in other work. This has been found to be very satisfactory and with the various conveniences attached, one can work much more rapidly. Nearly all of our insect and flower photography is done with this stand and our various

lenses are quickly attachable to a set of interchangeable lens-boards which fit this camera.

We have a complete series of Zeiss microscope objectives as well as various others, and find it a great convenience to have a long series, as we can always secure the degree of magnification and at the same time size of image that we require.

Magnification.—In our work on scale insects we have found it dedesirable to secure the required size of image by the use of a high power lens and short bellows rather than with a low power and longer bellows. This we have done for the sake of securing greater detail in the print. At the same time it is desirable to bring the whole object into focus if possible, and the higher the power used the less is the focal depth. One may, with a lower power and longer bellows, produce as large an image, but no more detail can be expected than is brought out by the power of lens being used.

In photographing thicker objects which present much detail, it is necesary to use a lower power and, if the length of bellows is not sufficient to produce the size of image desired, it is necessary to make enlarged copies from the negatives or prints.

Plates.—We have used several kinds of plates but prefer one made to our order by the M. A. Seed Company. This plate is their regular lantern slide emulsion on 4 by 5 glasses. It is difficult to estimate closely the proper exposure for scale insects of varying density and this plate allows us greater latitude in that respect and results in a saving of both time and plates.

Prints.—We have thought it desirable to dissolve out the background of our prints and obliterate parts of the image not required. This is done as the prints are removed from the fixing bath, by the use of a solution of hypo and potassium-ferri-cyanide. The print is placed, face up, on a piece of glass over a tray containing the solution. A swab of absorbent cotton is dipped in the solution and applied to the parts to be dissolved out. The glass is inclined so as to allow the solution to run away from the print and into the tray.

Regular glossy Velox paper is used when it is desired to obliterate parts of the print but, in general, Solio papers are to be preferred. The Velox prints are dried on a ferrotype plate as with Solio papers.

CHAIRMAN BRITTON: There is now a chance for a discussion of this paper.

MR. SKINNER: I wish to say that we have trouble in using the ordinary lantern slide plates. I would like to ask Professor Cooley

whether he has his plates treated with the emulsion and whether such plates are on the market?

MR. COOLEY: No; they are made by the M. A. Seed Company in gross lots.

MR. WASHBURN: What power lenses do you use?

MR. COOLEY: A Zeiss D, I believe, was used on this series of photographs and they are all the same scale of magnification.

A MEMBER: I would like to ask Mr. Cooley whether he thinks photographs will always bring out the surface markings that we can get sometimes by drawings. I think, with certain insects, like scale insects, we want to get an accurate representation of the insect as it appears.

MR. COOLEY: That is true. There are many kinds of illustrations in which drawing only will bring out what is desired. However, any one who has attempted to draw scale insects will realize that in the *Diaspinæ* it is very hard to bring out anything like what is wanted in a drawing.

A MEMBER: I think the two things have been reversed recently. That is, the drawing was the primary thing in times gone by, and it ought to be relegated to the second place. That is to say, it should supplement the photograph, if necessary.

MR. FELT: It seems to me that the making of photomicrographs is one of considerable importance, and I believe that quite a few have been deterred from attempting work along this line because of supposed difficulties. I want, for just a moment, to outline an apparatus which we have used at Albany, N. Y., with a good measure of success. We were situated so that we did not think it advisable to put a considerable amount of money into special lenses, or upright stands, or anything of that kind. We simply used the ordinary microscope, put it in front of a long bellows, and used a Welsbach lamp, and put a boy at one end to manipulate the slide and microscope, and a man at the other end, to give directions so far as adjustment was concerned. In that way, we were able to make a pretty fair series of photomicrographs. We could have made them better if we had had better equipment, but we found that in ordinary enlargements, fifteen, twenty, twenty-five or thirty diameters, we could make, with that make-shift apparatus, ten or twelve pretty good photomicrographs in an hour, with one man and a boy to attend the microscope. If you wish to get an idea of the work done by this outfit, I would simly refer you to Museum Bulletin No. 79 (N. Y.), illustrating some mosquitoes. I am satisfied that we can use ordinary lenses and work in the daytime. We all have practically that

outfit in the laboratory, and we can use it or not, and we don't have several hundred dollars laying idle in special apparatus, which is, perhaps, used only three or four days in the year.

CHAIRMAN BRITTON: If there is no further discussion, we will proceed with the next paper on the program, by Mr. F. M. Webster.

THE IMPORTANCE OF PROPER METHOD IN ENTOMOLOGICAL INVESTIGATIONS

By F. M. WEBSTER, *Washington, D. C.*

It is not my purpose to lay down a series of rules and regulations governing details in the work of any one; therefore the use of the word "method" instead of "technique." As a matter of fact, variety in insect life, and the conditions under which these must be studied, is so great that, beyond general principles, each investigator is forced to accept situations as he finds them and to make the utmost of his opportunities.

The spirit that prompted this paper came from the fact that the older entomologists of the country have, almost all of them, passed away, and those of us who, a quarter of a century ago, were young men are now also passing away, and a decade hence we shall nearly or quite all of us have practically given place to the younger men who now constitute by far the majority of the membership of this association. I thought that it might be possible for me to tell you of some of the things learned during nearly forty years' study of insects and insect problems, beginning at a time when entomologists were few, with no such training as is offered today available, and with precious few publications dealing with insect binomics. Strenuous days those, but in later years I have come to look back upon them with greater leniency and indeed feel thankful for them. Unfortunate indeed is the man who is denied the opportunity to show what his abilities really are, something that even he may not himself have learned.

With all of us who have the management of men there comes a time when an emergency arises and some one must be detailed to a most difficult piece of investigation, where only the most resourceful, persevering and trustworthy are to be employed, and lucky is the man who gets the opportunity. Now if I were to be asked to indicate some of the most essential qualifications for such a man I should say, first, honesty, and, second, common sense. Without these all of the training and equipment in Christendom will avail nothing. Some of us do not see as clearly or as broadly as others, it is true, which is of

course a personal misfortune, but not to be able to translate the truth, exactly as we see it, is a fatal defect. If there is a profession, the ministry not excepted, where clean men are more essential than in scientific research, it would be difficult to name it. Entomologists are not angels, and are not likely to become so in the future, in this world at any rate, but the man who goes after the truth for truth's sake is industrious, ingenious and persevering, will be about as sure of success as one day is sure to follow another. Incidentally, however, success does not consist of getting your name in the papers with the greatest frequency; the merest charlatan does that; nor does it mean exploiting yourselves before a few farmers who are seldom posted, for the untrustworthy have a monopoly in that direction. The man who beats the bass drum makes the most noise, but he is not the leader of the band. There is all the difference in the world between becoming famous and becoming notorious. You may secure fame or notoriety, but never both. A really good entomologist has no need of a placard advertising the fact, because in the process of his development he has been obliged to exhibit qualifications and combinations of qualifications that are never to be found in an inefficient man. No single qualification alone leads one to success, but one must needs be well balanced; be sufficiently pessimistic to be able to justly but fearlessly deal with defects in the work of others as well as his own, and yet be optimistic enough to see in advance sufficiently clear to formulate working theories and hypotheses without prematurely adopting these as fixed truths. Deficiency here is the reason for so many failures, and, often, too, failures that seem almost like the frivolities of chance. But it is not so. There is some defect, something lacking that is essential to success. Naturally the unfortunate himself will say it is due to a lack of opportunity or proper appreciation. Not every one is capable of grasping an opportunity when offered him, and as to appreciation, the world is not such an unjust judge after all, though it is sometimes very tardy in rendering a decision, and while the lines

> "Seven cities fought for Homer dead,
> While the living Homer begged for bread,"

finds a parallel perhaps all too frequently, yet such cases are, at most, not usual, and real success is, after all, in our leaving of the world better than we found it. Besides, it is often the fear of not being appreciated that drives men to make the mistake of chasing about after notoriety and in consequence accomplishing nothing meriting success. All of this leads me to make what may seem to you to be a remarkable

suggestion, and that is: Do not try to become famous or even noted except as a conscientious man. Get close to nature and throw the whole weight of every faculty that you possess into learning the truth unmixed with error, and get as near the whole truth as it is possible for one human to secure. Your province is to get facts sifted and tried by every clarifying process you can devise, with a view of eliminating obscurity and error. Pay absolutely no attention whatever to your own individual prominence, and as fast as you secure the real truths involved, just so fast will you gain the reputation of being something far above notorious. Success will not only come to you but be even begging you to take notice thereof. The old threadbare saying that "Some men are born great; others have greatness thrust upon them" is not true. Real greatness is never inherited; and the man who has real greatness thrust upon him has always bought it in some manner with the best years of his life. Substitute notoriety for greatness and I have nothing to say. The man in search of notoriety is generally the one that succeeds in getting in the way. In fact such is his usual mode of procedure in making himself notorious. For this reason the man who is trying with all his might and main to wrest from nature her most profound truths is obstructed by the one who, not knowing what truth and accuracy really are, will place himself squarely in opposition. Thus it is that the man who sets out to devote himself to dragging forth truth out of darkness or obscurity will find that his is not a bed of roses. Not only must he hold his own faculties under a continued surveillance lest he be cheated by his own eyes and mind, but he must always be more or less hampered by the frailties of those who find it easier to adopt other less commendable methods. Within the last two months there have come to my desk two publications from as many different states relating to two different though closely allied insects. In neither one is there anything new, nothing to indicate that either insect has ever been known outside the state where it is mentioned, and not a word to show that anyone, living or dead, except the author, had ever seen or studied the species. Quite recently one of the institutions from which one of these documents emanated published a newspaper bulletin, not necessarily by, or even with the knowledge of an entomologist, giving what purports to be the results of several years' experimentation, proving certain facts that were well known and established before that institution came into existence. Any well informed entomologist could readily cite the work of investigators, some of whom are still living and some dead, who contributed to the sum of this knowledge; but in this printed document to which I refer every

word is stamped with the mark of originality. Now such things as these have no relation to either scientific research or the diffusion of truth. They are, purely and simply, bids for the cheapest sort of notoriety, and will stand, if indeed they stand at all, in future as monuments of condemnation for whoever has been instrumental in their creation. The probabilities are, however, that they will be cast aside and disappear as of no value whatever and be eliminated precisely as any other impediment. After all, this whole matter of the separation of the truth from error and falsehood may be likened to a huge system of sifting screens, each screen perhaps representing a decade of time. All of the work of human intellect is thrown into a hopper and the mass begins to be shaken downward. Gradually mistakes, misstatements, jealousies, and all of the results of human frailties, the dross if you please, is discarded and finally at the bottom we have the net results of scientific research. Your success in life as investigators will depend not so much on the bulk that is thrown into the hopper and the noise and dust arising therefrom as upon how much of this pure fact at the bottom of the screens you can yourself lay claim to. I will show you in a moment how the identification may be made. This matter of proper credit as between superior and subordinate has several times been discussed by this body, always, as it seemed to me, with a too narrow view of the subject, making it something of a personal matter. I do not wish to discuss it in this way, as the question does not seem to me to be definitely understood.

Perhaps I can best approach the matter by offering an illustration. You may become estranged from your child; you may disinherit him, disown him and refuse to recognize him in every legal way. He may even be adopted by another. But still the blood of his father and mother alone will flow in his veins. Their ancestry will be his ancestry, and no law in the universe can make it otherwise. Now every original, unprejudiced observation made is the child of one mind and one pair of eyes, and these alone can be held responsible. There is here a certain entirely natural proprietorship that cannot be either stolen, given away or disowned, any more than a child can be disassociated from its ancestry. Whoever attempts to destroy this responsibility commits a crime, not against individuals, but against science itself, and no crime against science, which is only another term for truth, goes ultimately unpunished. Not only is this true with the original observation itself but all others following thereafter, whether contradictory or confirmatory.

When we come to the subject of publication, we are dealing with

the results of observation and investigation. The custom is, I believe, almost universal in all countries, which gives to the employing institution, for purposes of publication, all of the results of the labors of those in the employ of such institution. This seems entirely just, and there can hardly be serious criticism, so long as the observer is held responsible, given proper credit, and is not obliged to state what he does not believe to be true. There will probably always be occasional disregard of the rights of the observer, but these are not common and becoming less and less so every year. As the injury is not to individuals but to science itself, there is a certain losing of caste among those who do these things, which tends to prevent their occurrence. The question as to just when results should be published is a somewhat complicated one, and I sometimes wonder if the opinion of the investigator, even though a good one, is always the better. If we were to gather together all of the best of American investigators, I doubt if there would be one among them who would not recall instances where he had published prematurely and regretted it afterwards. To those who are in quest of notoriety, it of course does not matter. In my own experience, after working with a problem until there seemed no possibility of serious error, the results were printed and almost before the printers' ink was dry there would be sudden and unexpected developments that would completely upset previous conclusions. Indeed, it is strange how frequently such things will happen, even with what seems proper caution and the best of intentions. The older I get the more it seems to me that just here the investigator should be able to hold himself well in hand. Many a basis for a good piece of work has been spoiled by rushing it half seasoned, as it were, into print. Just here, too, is a point that younger men are prone to overlook. So long as matter remains unpublished all revisions or corrections constitute presumable added perfections; but once the matter is printed all of these become criticisms and reflect on the accuracy and conservatism of the author, even though he may himself make the revisions. Then again, these revisions of published papers may not in every case reach every one of those who have received the original and thus the misinformation at first diffused may not all of it be overtaken and rectified. While, then, admitting that there are cases where the matter of publication is in the hands of those who do not know what really constitutes an investigation and are mentally unfitted for judging the value of results, yet it seems to me that these instances are exceptional and that the prevailing custom is with these exceptions as good as we can at present devise.

There is, however, another feature of the question that should not be lost sight of, viz., one's duty to his colleagues. By this I mean he has not, morally, the right to horde up what he learns and thus prevent its being placed on record where other investigators may profit by the information. But, it may be suggested, this will flood our literature with unfinished work. It will inject into our entomological publications the many fragments of information that all good observers will and must accumulate in carrying on any other larger investigation; and the publication of these places them at the service of other workers. Possibly there may be one who is engaged on a kindred problem in another part of the world but who finds himself practically at a standstill for the lack of one of those fragments of science which he is unable to secure,—the key stone to the arch, as it were. Besides, we must remember that no entomological work is ever completed. The best that can be done only remains the best until some one with improved facilities and technique, or with added biological knowledge, shall be able to do better. I sometimes liken this to an endless stairway, with baskets placed on each step. The stair is progress and the basket the problem. An investigator, as he makes his way forward and upward, takes up a basket and carries it forward one or more steps, then sets it down and passes on into the unknown. Another follows and perhaps does the same, and in this way is advancement accomplished. I never take up a problem that was begun by Harris, Fitch, Riley, Lintner or others without a mental picture of the stairway and baskets coming to my mind's eye, and with a feeling of reverence for the good that these men, working with crude instruments, primitive technique and almost no literature at all, were able to accomplish, and wonder how far I shall be able to lift and carry the basket onward and upward before, like these men, passing to the great unknown beyond.

I have referred to a more perfect equipment because all of our instruments used in scientific research are continually being improved. Also I have referred to a wider and deeper knowledge of binomics. This leads me to say what you already must have remarked, that economic entomology today is not at all what it was ten years ago and it will not ten years hence be what it is today. If I mistake not, upon you younger men will devolve the duty of making many and diverse revisions. Our present system of classification will frequently be found wholly inadequate for your necessities, and our laws of priority are too ridiculous to stand except as an element of discord.

In dealing with the work of the systematist, I first wish to call at-

tention to the fact that this work has been, almost without exception, a labor of love, carried on by men with no thought of monetary compensation, and in the midst of lives exceptionally greatly preoccupied with human affairs around them. They did their best, considering the difficulties under which they were obliged to labor, and the monuments to their self-sacrifice and zeal are not to be ruthlessly torn down and obliterated. But we shall here have a case parallel with the old, low, weather-beaten, historic building giving place to the modern structure of concrete and steel. You to whom will fall the duty of this revision will need to look well to it that you leave these things more advanced than you found them. If I mistake not the time will come when no one will be allowed to describe a new species or revise a group of old ones without being able to present also something in the way of descriptions and explanations of the developmental stages or studies of habits, going to show, beyond a reasonable doubt, that the forms with which he has dealt are really what he represents them to be. So long as the science of entomology consisted in the collection and arrangement of dried corpses the system of classification in vogue was sufficient. But with the new era of entomological research, where insect binomics and the interrelations of different species are more and more generally and fully entered into, the structure is too frail and defective, so that almost as soon as we begin to build upon it we find it full of defects and inevitably it must be discarded and reconstructed on a much broader basis. These are problems that will be forced upon you and which will not for a moment permit slovenly or inefficient work. Please let me explain the use of this last sentence. In some quarters university people seem to be confirmed in the opinion that a graduating student can only make himself and his *alma mater* famous by describing something. It does not seem to matter much what, but once he has done this he has almost smothered himself and his university in a brain storm of glory; sometimes to the discouragement of the poor fellow, who, fortunately, is unable to comprehend the desirability of such proceedings; and I hope to have said enough here to sustain the latter in his stupidity.

Some of you may wish to remind me that a few moments ago I said something about the laws of priority. Only a single instance out of many will be required to illustrate the point that was made. *Smerinthus geminatus*, a common sphingid moth, was described by Say in 1824. It is a common, somewhat variable, species, the specific name, *geminatus*, having reference to the two ocelli on each of the posterior wings. In 1773 Drury described a single moth as from

Jamaica, figuring it with a single ocellus, giving it the specific name *jamaicensis*. Now in rearing a great number of adults from the egg an occasional individual of this latter form will appear, and all gradations between it and the true *geminatus* have been repeatedly observed, and may be reared from the same lot of eggs. The species has never been since found in Jamaica, and no one now believes for a moment that it ever occurred there, Drury's specimen probably having been mislabeled. Neither description nor figure represents the species but an occasionally occurring variation, and the name is not only a serious misnomer but misleading as well as false. Yet, on account of priority of publication, if the laws of priority are followed, this must be considered as the species. This is one of the things that must either be put out of the way or allowed to stand as perpetual contradiction and a discredit to the science of entomology. In the Fifth Report of the U. S. Entomological Commission, pp. 601–602, is a footnote by the late Dr. C. V. Riley, which reads as follows:

"The law of priority becomes a nuisance and a positive injury to the science when pushed to the unnecessary extreme of attempting to solve inexplicable riddles."

I have in the foregoing pointed out some of your frailties, for the man who makes no mistakes is yet to be born, and indicated some of the problems that the older entomologists will probably bequeath you for solution. Besides these, during the years to come, many biological problems reaching far beyond the realms of entomology will be solved by closer, broader, and more careful studies of insects and insect development. Never in the history of American entomology has there been so much to do, and a greater demand for the right kind of men to do it.

Those among you will succeed who adhere closest to nature, who throw all of the weight of every faculty that you can command into your work, with an eye to bringing out the truth for truth's sake, and not for whatever temporary glory or notoriety there may be in it, remembering always that it is not the bulk that you throw into the hopper but what remains and is not rejected through the siftings of years that will stand to your credit long after you have yourselves passed away.

(During the reading of the above paper, President Forbes entered and assumed the chair.)

President Forbes: Discussion of this paper is now in order.

MR. MARLATT: Mr. Chairman, I am very much pleased with and interested in the very thoughtful paper presented by one of the oldest of our members, and I wish to endorse with much heartiness his advice and suggestions. The field of entomology has increased enormously, the number of workers are a hundred times what they were not so many years ago and the amount of money expended has increased at a similar rate. When I entered the service of the Department of Agriculture the lump appropriation was twenty thousand dollars. Our appropriation now runs up to nearly half a million and the same relative increase has been seen throughout the country. With all this increase in entomological workers and funds and facilities, there has been a notable sub-division of the work. All the old problems that the pioneer entomologists attempted to solve are now attacked with a minuteness and specialization that was not then possible. The result is that as this old work is gone over the information is vastly increased, and errors are being constantly found. That is as it should be. The only point I wish to make is, that here and there you find in this new work a spirit of rather sharp criticism of the mistakes of the elders. It seems to me that this attitude is quite unnecessary. We should be charitable and remember that in those old days one man covered the field that is now covered by a score. Take, as an example, the white fly work in Florida, which has now been the subject of three years of continuous investigation by three men. Necessarily, they will find some of the older work faulty, and they will make large additions, but if the spirit of generosity and kindness prevails in these new workers, there need be no unpleasant or sharp criticism in the corrections which they necessarily make.

Looking over the work that is being put out today, the best work is by men who are most courteous and who have least in their writings that is unpleasantly critical. I think that credit should invariably be given. It is not necessary to fill pages with references to the writings of others. Credit can be given without interfering with the reputation of the writer in his own constituency and vastly increasing his reputation and standing in the field as a whole. I think entomologists may take a lesson from some of the other workers in science. There has been a good deal of controversial writing in entomology and bitter enmities have arisen through unnecessarily sharp criticism, through failure to approach one another in a spirit of friendliness and courtesy. I have quite an intimate acquaintance with chemists, and I think, as a body, the chemists are more closely knit. They get more fun out of their meetings; and they seem to have a more friendly spirit toward each other than that sometimes exhibited

by biologists. It seems to me that they, among the scientific men that I have known, have maintained that spirit of generosity, and friendliness, and courtesy which makes their meetings pleasanter and frees their publications from unnecessary criticism. Of course, there are exceptions, and the entomologists are perhaps less faulty in these particulars than others, but it seems to me that this point in Mr. Webster's address should be emphasized. I think we should endeavor to develop the spirit of leniency and courtesy rather than the reverse.

PRESIDENT FORBES: If there is no further discussion we will now take up the next paper.

BIOLOGICAL NOTES ON MURGANTIA HISTRIONICA HAHN.

By R. I. SMITH, *Raleigh, N. C.*

As a result of a somewhat disconnected study of *Murgantia histrionica,* I have ascertained a few points concerning the life history of this insect, which will be briefly presented, with the preliminary explantion that some of the work reported upon is not complete in many respects and may, by some of my entomological friends, be considered premature. However, it is hoped that the notes will be of some value as an addition to the knowledge of this troublesome pest.

Definite observations and notes were first made on April 4, 1908, at West Raleigh, N. C., where all the work herein recorded was done. On the date mentioned adult insects were found in abundance on turnip and collard plants, on which they were feeding and mating most actively. It was then observed that very few egg masses could be found and no nymphs were observed until ten days later, or on April 14. Hence this date is considered as approximately the beginning of the first seasonal brood for the year. Some springs may bring forth adults and young at an earlier date.

Notes on Egg Laying Habits

It is generally understood that twelve is the normal number of eggs deposited in each mass, and that these are ordinarily placed on end in two parallel rows of six each, closely cemented together, the eggs usually alternating like the cells of a honeycomb. As a matter of fact, more eggs are laid in more or less irregular masses than in two parallel rows of six each. Out of 94 egg masses laid by females under observation in the laboratory, 62 were irregular in form but contained 12 eggs each, and only 19 were regular, with 12 eggs each, while 13 masses varied in numbers from 8 to 14. Twelve eggs for each mass

is undoubtedly the average number, as evidenced by the fact that three females laid 11 eggs once and 13 eggs in the following mass, while another laid 10 and then 14 eggs. In all instances observed where less than 11 eggs were laid at one time, or where 11 eggs were deposited two or three times in succession, the female died shortly afterward.

The table giving the egg-laying record shows how often the egg masses are deposited, and it will be noticed that this time varies from two to fifteen days, but an average of about four days.

Concerning the time consumed by a female in depositing the eggs, a marked regularity exists. I have watched several egg masses deposited and find it takes about thirty minutes to deposit twelve eggs. A quotation from notes made at the time will serve as an illustration.

"April 15, 1908, 4 p. m. I have just watched and timed female of Pair No. 13 deposit a mass of twelve eggs. At 2.50 p. m. she was observed in the position assumed when about to commence deposition. She was apparently straining the abdominal muscles and moved the abdomen up and down occasionally, during which process she frequently stroked the tip of her abdomen with either hind leg. During this process a drop of moisture appeared, probably to serve as a glue for the first egg. At 2.56 p. m. the first egg was dropped, and the remaining number, making a regular mass of twelve in all, were deposited from 2.56 until 3.25, when the last egg appeared, or exactly twenty-nine minutes after dropping the first egg. Counting the six minutes that she remained in position preparatory to laying the first egg it required thirty-five minutes for the whole process. The time elapsing between the appearance of each egg is almost exactly 2½ minutes." If I had ten minutes before having to start for a train I would be willing to depend on measuring that time by watching a terrapin bug lay four eggs. Other observations have been made that verify this statement.

Incubation of Eggs

The incubation period varies greatly with the temperature. Eggs deposited from April 9 to 15 required an average of eleven days, some requiring twelve days, while from May 12 to 21 the average was about six days. In hot summer weather they may hatch on the fourth day.

Egg Laying Record of Hibernated Individuals

As already stated these observations were commenced on April 4th, when a very few eggs were present in the fields. Hence, of the fourteen pairs selected for the egg-laying record some may have deposited one mass of eggs in the field. For this record pairs were taken and

confined in large glass vials, with suitable food and a strip of blotting paper to absorb surplus moisture. It is my opinion that too little absorbent was used, the lack of which caused the premature death of some individuals. Six pairs were taken on April 4th, and eight pairs on April 7th. They were given fresh food (collard or cabbage) each day and the number of eggs counted and removed each morning. As the eggs are laid during the daytime the record is always one day behind as regards the actual date when the eggs were laid.

The shape of the egg mass, whether regular or irregular, and number of eggs are represented in vertical column, the letter "R" meaning regular, that is, two uniform parallel rows ("12-R" meaning 12 eggs in two rows of six each) and "I" meaning irregular ("12-I" meaning 12 eggs in an irregular mass).

DAILY RECORD OF 14 FEMALES OF THE HIBERNATED GENERATION.[1]

Date.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1908. April 7	12-I	12-R	12-R	......	12-I	......	......	......	......	......	......	......	......	......
8	......	......	......	12-I	......	12-I	......	......	......	......	......	......	......	......
9	......	......	12-I	......	......	12-I	......	12-R	12-I	12-I	......	......	......	......
10	12-R	12-I	......	......	12-I	......	......	......	......	......	......	......	......	12-I
11	......	......	12-I	......	......	......	12-I	......	......	12-I	......	12-R	12-R	......
12	......	......	......	11-I	......	......	......	......	......	......	12-I	......	......	......
13	12-R	......	......	......	......	......	......	12-R	12-I	......	......	......	......	......
14	......	12-I	12-I	......	12-I	11-R	......	......	......	12-I	......	......	......	12-I
16	......	......	......	13-R	......	......	12-I	......	12-I	......	12-I	12-I	12-R	12-I
17	......	......	......	......	......	......	......	......	......	12-I	......	......	......	......
19	......	......	12-I	......	......	......	......	12-I	......	......	......	......	......	......
20	12-I	12-I	......	......	12-I	11-R	......	......	......	......	......	12-I	......	......
21	......	......	......	12-R	......	......	12-I	......	12-I	......	12-R	......	......	12-I
22	12-I	......	......	......	......	......	......	12-R	......	......	......	......	......	......
23	......	......	12-I	......	12-I	......	......	......	12-I	......	......	12-I	......	Died
24	......	......	......	......	......	......	......	......	......	......	......	......	12-I	......
25	......	12-I	......	......	......	12-R	......	......	......	12-I	12-R	Died	......	......
26	......	......	......	12-I	......	......	......	......	12-I	......	......	......	Died	......
27	12-I	......	12-I	......	12-I	11-R	10-R	11-I	......	......	......	......	......	......
28	......	5	Died	......	......	......	......	......	......	4	......	......	......	......
29	......	3	......	......	......	......	......	13-I	......	Died	Died	......	......	......
30	......	......	......	......	......	......	......	Died	12-R	......	......	......	......	......
May 1	12-I	......	......	8-R	......	......	......	......	......	......	......	......	......	......
2	......	......	......	Died	12-I	......	......	......	......	......	......	......	......	......
3	......	......	......	......	......	Died	......	......	......	......	......	......	......	......
5	......	2	......	......	......	......	......	......	......	......	......	......	......	......

DAILY RECORD OF 14 FEMALES OF THE HIBERNATED GENERATION.[1]—*Concluded.*

Date.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1908. May 7	......	Died	......	......	......	......	14-I	......	......	......	......	......	......	......
10	......	......	......	......	......	......	......	......	12-I	......	......	......	......	......
12	12-I	......	......	......	12-R	......	......	......	......	......	......	......	......	......
14	......	......	......	......	......	......	......	......	11-R	......	......	......	......	......
15	11-R	......	......	......	......	......	......	......	......	......	......	......	......	......
16	......	......	......	......	12-I	......	......	......	Died	......	......	......	......	......
18	......	......	......	......	......	......	12-R	......	......	......	......	......	......	......
19	12-I	......	......	......	12-I	......	......	......	......	......	......	......	......	......
20	......	......	......	......	......	......	12-I	......	......	......	......	......	......	......
22	12-I	......	......	......	......	......	......	......	......	......	......	......	......	......
23	......	......	......	......	12-I	......	......	......	......	......	......	......	......	......
25	Died	......	......	......	......	......	12-I	......	......	......	......	......	......	......
27	......	......	......	......	......	......	12-I	......	......	......	......	......	......	......
28	......	......	......	......	12-I	......	......	......	......	......	......	......	......	......
29	......	......	......	......	......	......	12-R	......	......	......	......	......	......	......
31	......	......	......	......	12-I	......	......	......	......	......	......	......	......	......
June 3	......	......	......	......	......	......	Died	......	......	......	......	......	......	......
4	......	......	......	......	11-I	......	......	......	......	......	......	......	......	......
9	......	......	......	......	12-I	......	......	......	......	......	......	......	......	......
11	......	......	......	......	Died	......	......	......	......	......	......	......	......	......
Total egg masses	11	8	7	6	15	6	10	6	9	6	4	4	3	4
Tot. eggs	131	70	84	68	179	69	120	72	107	64	48	48	36	48

[1] Dates accompanied by no record were omitted from the original table.

This record indicates that both the length of life and number of eggs deposited varies considerably, but as a matter of fact, I believe that those females that died before depositing at least six egg masses would have lived longer under more favorable conditions. At the same time Nos. 2, 4, 8 and 10, females that deposited eggs quite irregularly toward the last, may very probably have died a natural death. Hence it would seem to me that by taking the average of the number of eggs obtained from females depositing at least six egg masses, we would have a fair average number that might be laid under normal or natural conditions. Granting this to be a correct supposition, we have 99 1-9 for the average number of eggs laid by each hibernating female.

Egg Laying Record of Second Seasonal Generation

To serve as a check on the egg laying record of the hibernated generation and to determine which, if either, lays the greatest number of

eggs during their life time, an attempt was made to get a similar record for individuals of the second seasonal generation. For this experiment nymphs in the last stage of development were collected from the field, taken to the laboratory, reared to adults and from them, on August 10, 1908, fourteen pairs were selected and isolated in 4-oz. bottles with suitable food. Unfortunately the mortality among these specimens was very high, due, I am now convinced, to an excess of moisture accumulating in the bottles. Consequently the record is unsatisfactory, but at the same time rather interesting.

Egg Laying Record of Fourteen Females of Second Generation

Out of this number separated on August 10 seven died between August 24 and 27, after laying from 12 to 36 eggs each. Three more died August 31, September 4 and September 7, each having laid 36 eggs. On September 21 another female died at 44 days of age from maturity, after laying 4 egg masses containing 46 eggs in all.

There remained only three females out of the original fourteen and as they laid a larger number of eggs and lived so much longer, their individual record seems to be of particular interest and is as follows:

The female of Pair No. 8 became adult on August 7 or 8, lived until October 5, or 58 days, and deposited 72 eggs, or a mass of 12 eggs each on the following dates: August 20 and 24, September 8, 17, 21 and 26.

The female of Pair No. 9 became adult August 8, lived until October 10, or 63 days, and deposited 71 eggs, or a mass of 12 eggs each,—except once, when only 11 eggs were found,—on the following dates: August 20 and 29, September 2, 10 (11 eggs), 17 and 21.

The female of Pair No. 10 became adult August 7 or 8, lived under observation until October 10, when she escaped, after depositing 84 eggs or 7 masses of 12 eggs each on the following dates: August 20 and 29, September 7, 11, 20, 25 and 29.

As already stated, it seems probable that the females that died so soon after maturity were killed by excessive moisture in the vials. In other words, the moisture caused them to adhere to the sides of the bottles, where they died in struggles to loosen themselves. As this experiment was followed closely, I feel confident in concluding that the average number of eggs deposited by the second brood is six or seven masses of 12 eggs each, or from 72 to 84 eggs. This is less than the average for the hibernating brood.

Concerning the Number of Generations Annually

In my opinion there are only three full generations in the vicinity of Raleigh. Some entomologists may be as surprised to hear this statement as I was to discover the fact. Owing to the numbers of nymphs present in the fields during November a fourth or fifth generation might be expected. However, there is a very strong argument against that being the case. I was unable to secure eggs from any terrapin bugs becoming adult later than September 1. A considerable number were reared in the laboratory and kept under observation to determine this fact. Since we know that adult females may live and deposit eggs for more than two full months, the presence of young nymphs in the field even as late as early December may be accounted for, and they may be classed as belated individuals of the third generation.

The statement that there are only three broods cannot, unfortunately, be absolutely proven because I was unable to follow the development during the summer vacation. However, the statement is deduced from the fact that the first generation at Raleigh, that is the earliest maturing individuals, became adult on May 25, and deposited eggs nine days later, or on June 4. These eggs hatched on June 8. I found therefore that the first generation required fifty-one days, not including eggs, from April 14 to June 4, to become full grown and deposit eggs, and subsequent rearing experiments do not show much more rapid development during the hot months of summer. Furthermore, May 25 is the date of maturity of the first individuals of the first generation, while the majority were not mature until at least ten days, or two weeks later. It may be true that some bugs of the third generation mature before September 1 and commence to lay eggs, but I feel convinced that the majority of the adults of this generation do not lay eggs, but live over winter as the hibernating form.

Length of Life Cycle

There is some variation in the duration of the young stages, particularly the 4th and 5th instars. Chittenden in Bulletin 103, Bureau of Entomology, records the life cycle for bugs hatching in March as 70 days, including the egg stage, which covered 11 days. My record of bugs that hatched on August 24 and 25 shows the life cycle, exclusive of the egg stage, covered from 57 to 65 days.

The following table shows the record of four individuals which were kept in the laboratory—not heated—during the time recorded:

LIFE CYCLE OF FOUR HARLEQUIN BUGS

No.	Hatched.	End of 1st Instar.	End of 2d Instar.	End of 3d Instar.	End of 4th Instar.	End of 5th Instar. Becoming adult.	Total No. Days.
	1908						
1	Aug. 25	Aug. 30-31*	Sept. 7-8*	Sept. 15	Sept. 27	Oct. 23	59
2	" 25	" 30-31*	" 7	" 15	Oct. 2	" 29	65
3	" 24	" 30	" 7-8*	" 16-17*	Sept. 26	" 20	57
4	" 24	" 30	" 7-8*	" 16-17*	" 30	" 27	64

* Indicates that molt occurred some time between 5 p. m. and the following 8.30 a. m.

As evidence that the duration of the 4th and 5th instars may vary it is only necessary to study the above table, and as further proof compare these dates with the time recorded by Chittenden, as above mentioned. He states: "The first or egg stage covered 11 days. The time from the hatching of the eggs until the first molt gave the first larval instar or nymph period, 7 days; the second instar required 13 days; the third, 8 days; the fourth, 14 days, while the fifth or pupal instar covered 17 days, a total of 70 days or 10 weeks . . . "

Means of Suppression

From an economic standpoint this work indicates that Harlequin bugs should be fought vigorously in the fall, particularly after September 1st, in order to prevent the young forms from maturing and going into hibernating quarters. It also serves to emphasize the fact that the adults first appearing in spring should be collected or otherwise destroyed before they commence egg deposition. I am convinced that the hibernating adults are more prolific than the succeeding generations, which makes it most advisable to destroy them late in fall or early in spring.

Parasites succeed in destroying a large per cent. of the eggs, but in all my work this season with nymphs and adults no parasites were secured from them.

PRESIDENT FORBES: The next on the program are papers on apiculture by Mr. E. F. Phillips and Mr. B. N. Gates.

MEANS WHEREBY THE ECONOMIC ENTOMOLOGIST CAN ADVANCE APICULTURE[1]

By E. F. Phillips, *Washington, D. C.*

Bee keeping in the United States is progressing and considerable advances are being made in various phases of the work, but there still remains much to do before apiculture as an industry takes its rightful place as a phase of scientific agriculture. The honey resources of the United States are very great. At present vast quantities of nectar are wasted every year because of the lack of bees to gather it, and, even where bees are kept, the wastefulness due to crude and improper manipulation is entirely too great. Persons interested in the advancement of this industry fully realize this condition of affairs, but the difficulty is to set in order machinery whereby these conditions may be overcome.

Apiculture is a branch of economic entomology and should be recognized as such. It is true that the nature of the work is quite unlike that of most of the work in economic entomology in that the object is to propagate rather than to destroy. The difference is not so great, however, when it is recognized that apiculture is primarily a study in life history but of a very detailed nature.

At present apiculture is advancing somewhat slowly and for two reasons. The main obstacle is bee disease, which causes a great annual loss to the bee keepers of the country and prevents the enlargement of operations. The second obstacle and the one of which I wish to speak particularly, is the need of competent and comprehensive research and educational work among those interested in bees.

In speaking of the work which the economic entomologist may do in helping this industry, there are several points which may be mentioned at once to forestall any presentation of them as objections. The economic entomologist is a very busy man and work on bee keeping would be adding to his already heavy work. The amount of money available for a new line of work is usually small or possibly entirely lacking and, in most cases, work on bee keeping would be a new line of work. The training for work on bee keeping is not usually included in that furnished a prospective economic entomologist and it is a safe assumption that the practical manipulation of bees would be new work to most men engaged in state work. It therefore follows that any work which may be undertaken, in most cases at least, must

[1]This paper was read by title at the meeting, but as it is closely related to the one which follows, it is inserted at this point in the report.—Secretary.

be such as to require little time and money and a rather meager knowledge of practical bee keeping.

In a recent paper[1] I discussed the need and possibilities of apiculture and classified the needs as scientific, economic and educational. The scientific needs are those resulting from a lack of proper research along statistical, zoölogical, botanical, chemical and bacteriological lines. There is no real line of demarkation between scientific and economic needs, since economic work is but the application of the results of scientific work. The educational work is the presentation of the results of scientific and economic research to the man who needs it. In part of these lines of work at least the economic entomologist may be of the greatest help.

The furtherance of the work depends largely on a definite knowledge of the present conditions of bee keeping, and to this end the Bureau of Entomology has undertaken the compilation of statistics as to the conditions of bee keeping in Massachusetts. Of the technique used in this work, Mr. Gates will speak more fully. Similar work is being undertaken in Maryland in coöperation with the State Entomologist. The work in Massachusetts has already resulted in great good in stirring the bee keepers to greater activity, and they are now actively engaged in getting a disease inspection law passed. In Maryland, with the work just begun, a good bee keepers' organization has been established as a direct result of the work. This work is too large an undertaking for the Bureau to undertake in all the states, nor does it seem desirable, for this is work which seems more properly to belong to the state. The advantage of a detailed knowledge of the present status of the industry, with information as to the honey resources, is of inestimable value in planning educational work. This work involves considerable time and may, therefore, be out of the question for many state entomologists.

There are, however, several lines of work which suggest themselves. In a paper which I read before this association a year ago,[2] I urged that the state entomologists interest themselves in bee disease work. There is no other line of work in most states that would be of greater help to the industry. The distribution of bee diseases in the state is undoubtedly the best argument which can be used in asking for new laws and where laws already exist this should be definitely determined as an aid to the inspector and as an educational measure. This the

[1]Phillips, E. F., 1909. The Status of Apiculture in the United States, Bulletin No. 75, Part VI. Bureau of Entomology.

[2]Phillips, E. F., 1908. Bee Diseases: A Problem in Economic Entomology. Journal of Economic Entomology, Vol. 1, No. 2, pp. 102–105.

entomologist can do with little work. He can soon learn to diagnose American foul brood and most cases of European foul brood. In case of doubt, the Bureau of Entomology will be glad to make bacteriological examinations. The examination of samples not only is the means of identifying samples for bee keepers who do not know the diseases, but publications may be sent out or recommended giving methods of treatment.

It need not be pointed out that Farmers' Institutes are an important factor in agricultural education. The state entomologist may, without great effort, see to it that talks on bee keeping are included in the institutes, either by himself if he feels able to do it or by some good practical bee keeper. There is an element of danger in this work which should be mentioned. Bee keeping is not an industry in which every one can engage with profit and Farmers' Institute talks should not be of such a nature as to induce great numbers to take up the work. They should aim to make better bee keepers of those now in the business and encourage only careful persons to begin it. Any other procedure will lead to grave disappointment. The state entomologist may well exercise a little supervision over these talks to eliminate wild nature-faking, which is too often a fault with bee talks.

In traveling about the state the entomologist often has opportunity to give out information on bees and to get information of value to other bee keepers. It would be better if he could give out information himself in person or in letters or bulletins, but, if not, he can put the bee keepers in touch with the Bureau of Entomology.

A METHOD OF SECURING APICULTURAL STATISTICS

By Burton N. Gates, *Washington, D. C.*

Until recently, the only source of statistical information on apiculture has been the Federal Census; but, unfortunately, this is found incomprehensive. It fails to strike to the root of the industry and to give fundamental information, as for instance, on the prevalence of bee diseases, prevailing methods and implements, progressiveness in certain sections of the country, enemies and like economic problems. Such things the one who is attempting to promote apiculture must know. They are also of interest to the bee keeper, who cannot be enlightened by the Census Reports. Moreover, there is considerable evidence that the data presented in the Census Reports does not adequately picture the importance and magnitude of the industry. The

report for 1900[1] distinctly states that "the statistics of agriculture do not include any data . . . relating to animal products or crops raised by persons who pursue some calling other than agriculture, but incidentally care for a tract of land too small to be called a farm." Any one who is acquainted with bee keeping, in the East particularly, readily sees that this one fact could vitiate the significance of the statistics.

The plan to be presented was first tried on a small scale on Worcester County, Massachusetts.[2] Since then it has been perfected and tested on the state as a whole by the Bureau of Entomology.[3] As evidence of the extent to which the work has already benefited bee keepers, it may be stated that whereas a year or more ago the majority of apiarists laughed at the possibility of bee diseases existing in Massachusetts, today they are united in an effort to procure legislative protection and the appointment of a bee disease inspector. Furthermore, there is news of two new bee keepers' organizations in western Massachusetts.

It should be emphasized that the method to be presented is not limited to apicultural investigations, but may be adapted and extended to the study of the status of any agricultural industry, crop or pest.

The statistics were gathered by a questionary method, operated under frank through the mails. The frank proved to be an exceedingly important factor in securing a high percentage of replies. Besides relieving the expense of postage, experience shows that there is an element of authority or charm in the franked envelope, which doubtless brought replies from many who otherwise would not have responded. However, even without the frank, it has been demonstrated possible to secure much valuable information.

In beginning the work, it was first necessary to locate the bee keepers. A printed letter was mailed to every town clerk and to each Grange secretary in the state. The letter stated briefly the project and requested names and addresses of bee keepers. Replies from the town clerks were more prompt and complete than those from the secretaries. But even more satisfactory were the returns from a few postmasters who were written to because of a failure otherwise to locate bee keepers in their vicinity. Were it possible to work exclusively

[1] 12th Census, Vol. V, Parts 1 and 2, pp. xiii–xiv.

[2] Gates, Burton N., 1906. Status of Bee Keeping in Massachusetts in 1906. American Bee Keeper, Vol. XVII, pp. 79–81.

[3] Gates, Burton N., 1909. Bee Keeping in Massachusetts. Bulletin No. 75, Part VII, Bureau of Entomology. U. S. Dept. of Agriculture.

with the postmasters, the writer feels sure that this would be the most efficient and rapid course.

As fast as the addresses were received they were transferred to cards for filing. Two kinds of cards were used:[4] one set served as an index to the bee keepers of the state, and were filed alphabetically according to name. The other set constituted the record file and were arranged geographically by county and town. In this way there was a double and automatic check on duplicating entries. In transferring the addresses both cards were struck off on the typewriter at one operation, which not alone saved time but made certain that one card bore the exact inscription of the other. Experience taught that the work of locating the bee keepers should be begun several months before sending out the questions to the bee keepers.

Each bee keeper thus located was sent a list of questions to answer and return. This was brief, worded so as to be impossible of misinterpretation, and answerable by yes or no, by figures, or by a few words, such as the name of a hive. The order of the questions corresponded with the order of the columns and spacing on the record card. This, with the brief answers, facilitated the recording of data. At the end there was a request for names and addresses of bee keepers. It also proved advisable to give a chance for "remarks," which brought out much information not prompted by the questions.

Printed at the head was a list of the available publications of the Bureau of Entomology relating to apiculture, together with directions for obtaining them. The bee keeper was permitted to check such free bulletins as he desired. In this there was an incentive to reply to the questions, acting similar to a "free premium" in advertising. Furthermore, as a result, hundreds of bulletins were placed directly in the hands of those who wanted and appreciated them, circumstances which do not always prevail with government and experiment station literature.

After two or three weeks, if no reply was received from the bee keeper, a duplicate copy, on the corner of which was stamped in red ink, "SECOND REQUEST. *An Immediate Reply Is Earnestly Requested,*" was sent out. This stirred up delinquents, amply paying for the time and labor. Finally from sixty to seventy per cent. of those listed in the files were heard from. The remainder were probably small, one or two hive bee keepers, and consequently did not materially affect the results.

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[4]Cards used for the address file were about 3 x 5 inches (Library Bureau Standard). The record cards were about 5 x 8 inches. (Library Bureau Standard).

As fast as the returns came in they were arranged preparatory to recording by county, town and name of bee keeper, corresponding to the arrangement of the record file. Recording was done on the typewriter, in symbols and abbreviations. Thus "8 L" stood for eight frame Langstroth hive; "It" or "It.x" represented Italian bees or Italian hybrid; "E. F. B." designated European foul brood. If a bee keeper was reported "deceased" or "out of the business" it was found best to so mark his cards and retain them in the files.

Gradually as the work progressed, through the fullness and character of reports, representative apiarists were selected and designated "Informants." These served as correspondents, and in many cases were asked for details of certain interesting local conditions. In some instances informants assisted in obtaining replies from neighbors who were indifferent in responding. In three cases very valuable and detailed information was received on local nectar floras. The discovering of reliable correspondents was an exceedingly valuable feature of the work.

The results of the writer's study in Massachusetts will illustrate what is possible in a state where no definite knowledge of conditions was previously available. In the first place more than 2,100 bee keepers were located, which was several hundred more than recorded in the 1900 Census. Between sixty and seventy per cent. of these reported. The size of crops were obtained. It was possible to learn the prevailing types of hives and to what extent the old-fashioned box hive still exists. Foci of American and European foul brood were located. Lists of the most important honey plants were made up. The extent of the trade in queen bees and colonies of bees and the extent to which bees are used in cucumber greenhouses was ascertained. Some sections of the state were found more progressive than others. Such things are not afforded by the Federal Census.

Tuesday Afternoon Session, December 29, 1908

The meeting was called to order at 1.00 p. m., with President S. A. Forbes in the chair.

President Forbes: The first paper on the afternoon program will be presented by Mr. C. E. Hood.

TYPES OF CAGES FOUND USEFUL IN PARASITE WORK

By C. E. Hood, *Dallas, Texas*

In the breeding work connected with the boll weevil investigations the inability to carry through a large percentage of the weevils and parasites showed very plainly the inefficiency of the various types of cages which were then in use. It was therefore necessary to construct several new cages furnishing more nearly the natural conditions under which the various weevils and parasites live. The object of this paper is to give a brief description of these cages, their advantages, and some of the results already obtained from their use.

Most of the breeding work at Dallas, Texas, has been carried on out of doors in a remodelled hibernation cage. This consists of a frame of two by fours, measuring ten feet on each side and seven feet in height, the top and sides of which are covered with 14-mesh wire screen. A roof was built over this and shelves arranged for cages on three sides. With such a cage it was possible to produce more natural conditions of temperature and humidity than were possible before in the breeding room of the laboratory.

Indoor Breeding Cages

Of the various cages used, our five-section cage is the largest. This measures four and a half feet in length, ten inches in width and twelve inches deep. The bottom and ends are of wood, the top and back of 50 mesh wire gauze and the front of glass. This cage is divided into five sections by wooden partitions, each section being entirely separated from the others. The panes of glass in the front can be raised or lowered and serve as doors. Pieces of felt-edged weather stripping are used in the grooves in which the glass slides to insure tightness.

This has proven to be a very satisfactory breeding cage. One disadvantage, however, is that the insects attracted to the light collect on the glass and it is impossible to get them without disturbing or oftentimes crushing some of them. This difficulty has been overcome almost entirely by having the side opposite the glass made of wood instead of wire, with a small door in the center large enough to admit the hand. To secure isolation from ants and mites, nails are driven part way up into the bottom of the cage, one on each corner, and the heads are set in small cups of vaseline or axle grease.

For smaller lots of material the box cage has proven to be quite satisfactory. This is a wooden box of the style used by the California Board of Horticulture. It is ten inches long, six inches wide and six

inches deep. This box is fitted with two covers, the inner one glass, the outer one wood. With such an arrangement it is possible to examine the material without allowing the insects to escape. Three holes are bored in the front of the cage, one inch in diameter, and in these are placed glass tubes about four inches in length. Insects attracted to the light come out into the tubes, where they can be easily collected. A layer of sand on the bottom of the box makes conditions favorable for larvæ that enter the ground for pupation.

If it is desired to watch the larvæ that enter the ground they are put into the double tube cage. This consists of one tube inside of another, the inner tube having no bottom. Dirt is placed between the tubes and the outer tube is encased in black paper. Water placed in the middle tube passes through the dirt by capillarity, keeping the ground in a moist condition. This inner tube because of the light forces the larvæ to the outside of the outer tube, where they can be readily seen by removing the black paper.

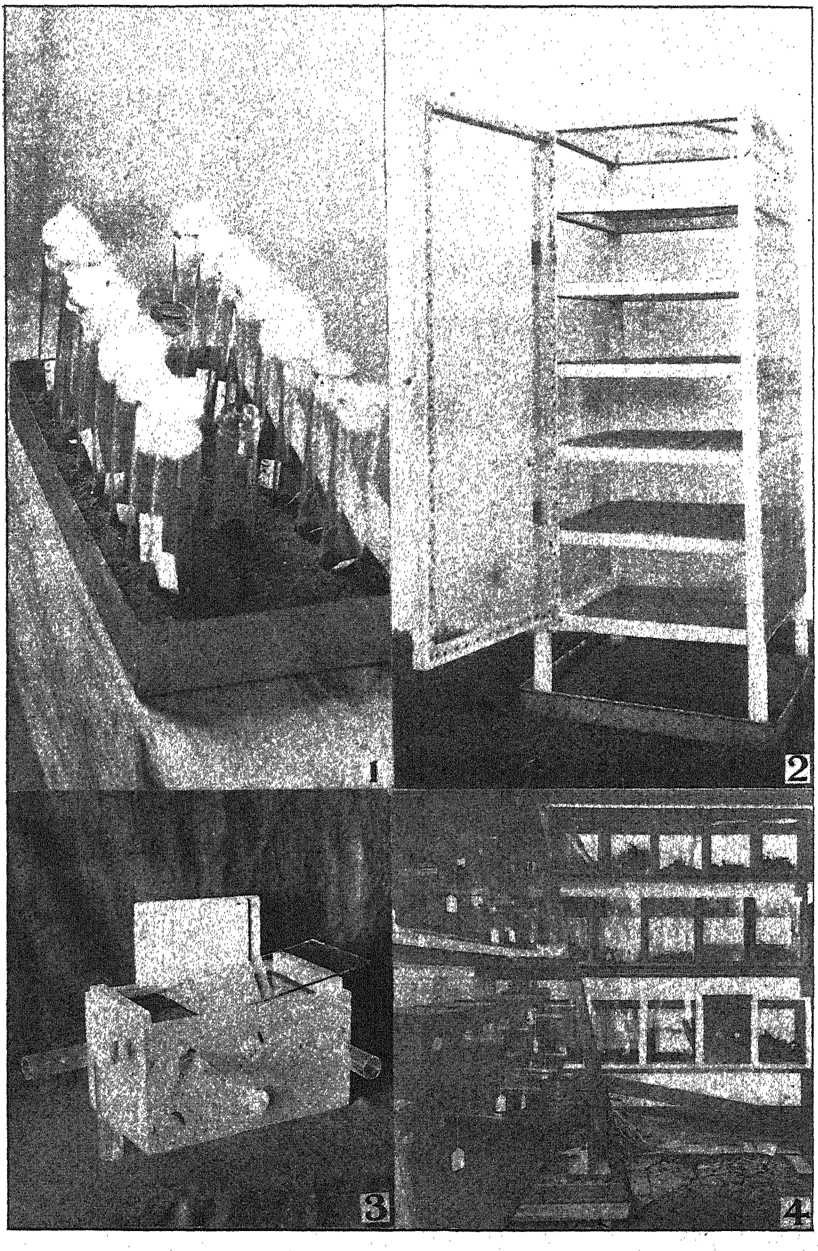
Smaller lots of breeding material are kept in tumblers in which has been placed a layer of moist sand. The tops of the tumblers are covered with cheese cloth held in place by elastic bands.

In our parasite breeding work it is desirable to obtain correct data on the length of development of the various stages. In order to do this each specimen is isolated and so labelled that the data on the individual specimen can be referred to at any time. These specimens are isolated generally as larvæ or pupæ in glass tubes with cotton stoppers or in gelatine capsules.

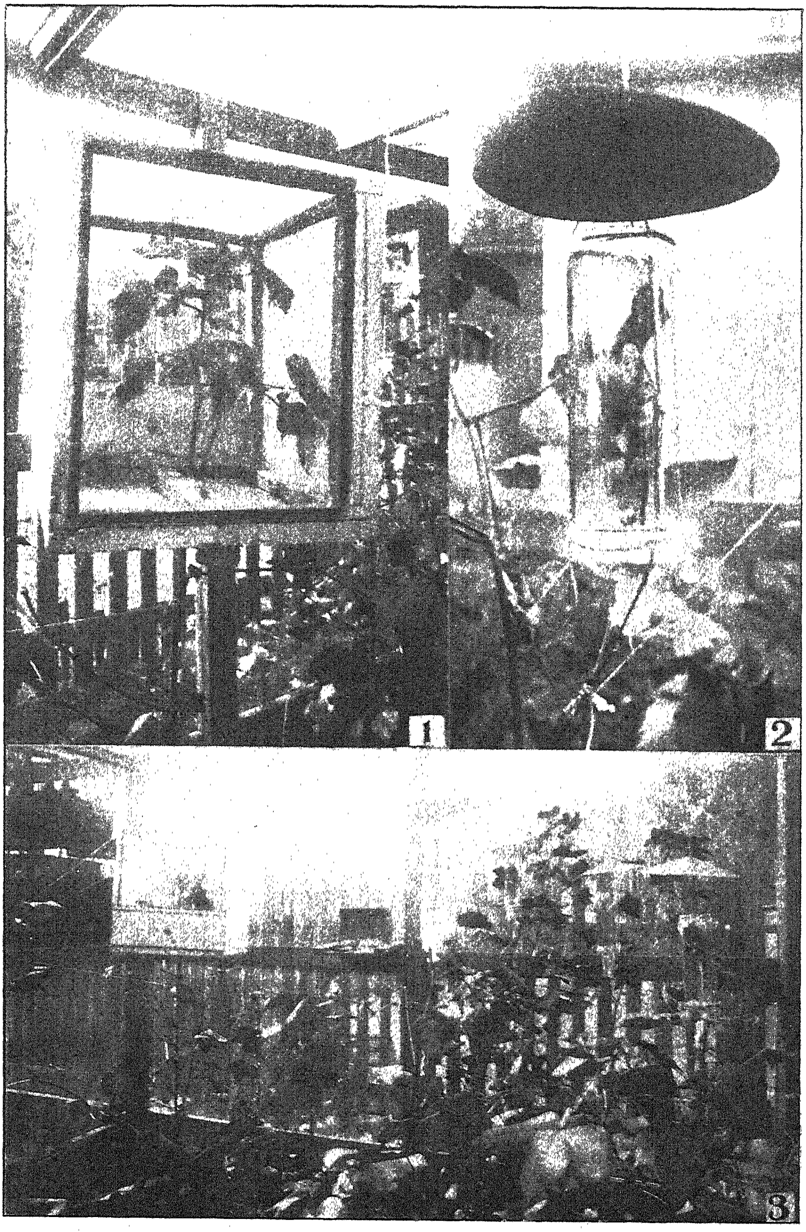
The Dipterous parasites are somewhat harder to carry through to maturity because of the lack of proper conditions of moisture. This has been supplied by a new type of cage. It consists of a tray filled with about an inch of sand. Glass tubes without bottoms are placed in the sand in an upright position. By means of two of these tubes, which are filled with water, the sand near the bottom of the tray is kept wet, while the sand on the top is kept moist from this by capillarity. A single Dipterous larva is placed in each of the remaining tubes, the tops of which are closed with cotton stoppers.

Plant Cages

Perhaps the most interesting type of cage in use at the laboratory is the mica plant cage. This consists of a mica tube eight inches long and two and a half inches in diameter, such as are used as chimneys for gas lights. One end is closed with cheese cloth and on the other end a cuff of the same material is fitted so that the tube can be placed over the top of the plant and the loose end of the cuff tied tightly



1. Dipterous breeding cage; 2. Outdoor parasite release cage; 3. Indoor breeding box; 4. Section of outdoor breeding house.



1. Large plant cage in operation; 2. Mica plant cage in operation; 3. Large plant cage and mica cages in operation.

around the stem of the plant. On the sides of the tubes are three small metal rings. Pieces of strong string or twine fastened to some support above the cage pass down and are secured to these rings. They then are continued downward and after being pulled taut are tied to the stem of the plant below, where the cuff is attached. In this way the strain caused by the swaying and blowing of the plant is not brought to bear on the cage but on the stem below the cuff and on the support above. On the side of the cage a small opening is made for the admission of parasites. It is closed by a mica slide or a cotton stopper. About three inches above the tube a circular piece of cardboard about eight inches in diameter is placed. This is to protect the cage from rain and also from the direct rays of the sun.

In using this cage for our parasite work, weevil-infested squares freshly punctured are tied to the top of the plant. The mica tube is then slipped on over them and the cuff is tied to the stem below. The twine is fastened to the support above and to the stem below the cuff, and lastly the parasites are admitted through the opening in the side.

Up to this time great difficulty had been experienced in perfecting a plant cage which did not sweat. In the use of this cage this fall under the most favorable conditions for sweating very little moisture collected in the tube. What little there was was soon taken up by the cheese cloth. This type of cage furnishes plenty of light and air, the parasites are abundantly supplied with nectar from the floral and other nectaries of the cotton plant for food and in every way they seem to feel perfectly at home.

Very few observations on the oviposition of Hymenopterous parasites, especially the Chalcidids, have been placed on record, but notwithstanding the fact that these cages were not put into use until about October 1st, notes on the oviposition of two species of Chalcidids and two species of Braconids have been made.

Another plant cage for similar work but very much larger was tried for a short time and seems to work equally as well as the mica cage. This cage is about a foot square and fifteen inches in height. It consists of a wooden framework with fifty mesh wire gauze on one side and a sliding glass door on the opposite side. The other two sides, the top and bottom are covered with cheese cloth. A cross piece divides the bottom of the cage equally. One half of the bottom is immovable, while into the other half a door is fitted which opens downward. A small hole is bored in the center where the edge of the door and the crosspiece meet. Into this the stem of the plant fits. Another small hole is bored in any available space in the frame work to admit the

parasites and is closed with a cork stopper. Guy strings may conveniently be attached to prevent movement by the wind.

With this cage a larger portion of the plant can be enclosed, more squares can be supplied and more parasites placed under observation. The very size, however, prevents as close observations as are possible in the smaller cage. The oviposition of *Sigalphus curculionis* has already been observed in this cage.

Field Cages

To facilitate the increase of parasites in the cotton field, cages of fourteen mesh wire are used, in which are placed the hanging or fallen infested squares. Wire of this mesh enables all of the parasites to escape, but only a very small percentage of the weevils.

This cage is fifteen inches square and three feet high. It is covered on all sides, top and bottom with fourteen mesh wire. Five wire shelves are built in this cage, five inches apart, and on these are placed the infested forms. These wire shelves allow a better circulation of air, which keeps the material drier and also prevents heating and molding. One entire side forms the door, giving access to all of the shelves. When in the field this cage is kept free from infestation by ants or mites by placing the legs in a zinc tray containing two or three inches of water.

Other types of cages have been made but as yet their usefulness has not been proven by actual test.

President Forbes: Any questions to ask or discussion of this paper?

A Member: Mr. President, we had an interesting experience in trying to get parasites into tubes while studying a certain moth. We put them in a box fitted with glass tubes and we secured neither moths nor parasites. They had formed the habit of breeding in the dark and they would not come out to the light.

President Forbes: If there are no further remarks the next paper will be read by Mr. Parrott.

TREE CRICKETS AND INJURY TO APPLE WOOD

By P. J. Parrott, *Geneva, N. Y.*

During the past two years our attention has been directed to discolored areas on apple limbs, which have the appearance of being the early stages of a canker. These diseased spots have usually a dark

reddish brown color, with a purplish tinge, and they are more or less circular in outline, varying from one quarter of an inch to one inch in diameter. From these there are occasionally lateral extensions of dead and depressed bark, which may be larger than the original wound. In comparison with published descriptions of the various canker diseases known to attack apple trees they resemble closely the pit cankers, which have been shown by Whetzel[1] to be due to the same bacterium which causes the blight of the pear. Our interest in these cankers was aroused by discovering that in many of these affected areas, usually about the center, there was a puncture in the bark, which generally led to an orthopterous egg. From these eggs young tree crickets have been hatched, which on attaining maturity were kindly identified for us by Dr. W. S. Blatchley as *Oecanthus niveus* De Geer.

Injuries of this character by this cricket have been mentioned by other writers. In 1898 Dr. A. D. Hopkins[2] described a cankerous condition of bark, which was common in the older apple orchards, and obtained eggs from apple branches, which he identified as belonging to a species of tree cricket. The diseased areas were attributed to blight and woolly aphis, which apparently became established in the wounds made by tree crickets in ovipositing. More recently Prof. C. O. Houghton[3] mentioned the occurrence of an insect's punctures, sometimes accompanied with depressed areas of bark, which were abundant on the trunks of young plum trees. In the wounds were eggs, from which specimens of *Oecanthus niveus* De Geer were reared. Similar punctures, although fewer in numbers, were observed in the bark of small apple and peach trees, and in raspberry canes.

In our studies on the habits of the Snowy Tree Cricket on apple, we have found that eggs of this species are quite common on neglected trees by the sides of ravines and highways, or on trees in orchards that are given indifferent tillage or are grown in grass, in which weeds to a more or less extent abound. Punctures in the bark by this species are quite common with both old and young trees growing under these conditions about Geneva. One Red Astrachan, surrounded by trees of the same age of other varieties, seems to be especially attractive to these insects. No difficulty is experienced in obtaining goodly numbers of eggs from limbs of this tree averaging about six inches in diameter down to branches as small as one inch in diameter. The bark

[1]Bull. 236, N. Y. Cornell Sta.

[2]Bull. 50, W. Va. Exp. Sta., p. 39.

[3]Fifteenth Ann. Rept. Del. Exp. Sta., p. 150, and Entomological News, Vol. XV, p. 57.

of the wood of these dimensions is very much punctured by crickets, and encircling many of these wounds are the discolored areas of bark as described.

This marked difference in the manner of oviposition by the Snowy Tree Cricket, from the common description of the habits of this species in this particular, prompted some experiments to obtain more data on the egg-laying habits of this insect on apple and raspberry. Fifty-five specimens of *niveus* reared from eggs deposited in apple bark, and thirty adults collected from raspberries were confined in various lots without mixing in breeding cages, in which were growing either nursery apples or raspberries. The insects oviposited freely, and more eggs were laid in the apples than in raspberries. In every instance only one egg was inserted in each wound, and the eggs were deposited irregularly and not in linear series, as with *O. nigricornis* Walk. In similar experiments with the latter species (*nigricornis*) the eggs were inserted in continuous rows, although occasionally single eggs were deposited, the female apparently having been disturbed before a larger number were laid. On young apples of four years of age the eggs of *niveus* were most abundant about the crotches of the trunks and larger limbs, while the eggs of *nigricornis* were deposited in the tips of the new growth.

The eggs of *niveus* obtained in the fall are generally pale yellow in color. The chorion has a delicate sculpturing, which is composed of fine lines, which are intersected, forming patches of tiny rectangles. The egg cap is yellowish or light brown, concealed with more or less pollinose. With magnification it has a honeycombed appearance and from the surface project cylindrical spicules, which are gently rounded at the tips. The measurements of twenty-five eggs gave an average length of 2,871 microns, and an average width at the broadest portion of 645 microns. The average length of the egg caps in this series was 511 microns and the average width was 521 microns. In the thick bark on the larger limbs and about the base of fruit spurs the eggs are inserted at an angle of 30° to 45°, while in the thin bark of the younger growth they lie almost flat on the wood. The tissues surrounding them become hardened and form a tough, protective case, from which it is difficult to remove the eggs. In the breeding cages oviposition commenced on August 20 and continued until August 31. Hatching of eggs began on May 25 and lasted until June 18. The first adult was observed on July 20.

The eggs of *nigricornis* vary from a light to a medium chrome yellow. The egg caps are cream or a light yellow, with sometimes a tinge of brown on the ends. Examined with a microscope they have a

honeycombed appearance and short spicules. The chorion has a sculpturing that is similar to *niveus*. The average length of twenty-five eggs that were measured was 2,924 microns and the average width on the broadest portions was 580 microns. The length of the egg caps averaged about 342 microns and the width 447 microns. The eggs of this species differ from those of *niveus* in that they are more slender and are of a deeper yellow in color, and have shorter spicules on the egg caps. Injuries to raspberry canes by *nigricornis* are common.

PRESIDENT FORBES: Discussion of this paper is now in order.

MR. HOPKINS: Mr. President, I am especially interested in this paper and am glad to know the species concerned, because it has always been a mystery to me as to what species caused the damage. My observations, however, are that the eggs were deposited almost invariably in pairs and that in a great many cases the canker did not follow the puncture. (Mr. Hopkins then exhibited a plate which he had published in Bulletin 50, West Virginia Agricultural Experiment Station, illustrating the work of tree crickets.)

MR. PARROTT: I do not want to leave the impression that the cankerous condition was common with all the punctures. This was not the case. It was present, however, with many of the punctures.

MR. SLINGERLAND: We have one of our graduate students at Cornell working on this problem and his results are similar to those of Professor Parrott.

PRESIDENT FORBES: Any further discussion? The next paper on the program will be read by Mr. H. E. Summers.

THE DISTRIBUTION OF SAN JOSE SCALE IN IOWA

By H. E. SUMMERS, *Ames, Iowa*

As the line marking the northwestern limit of injury by the San José scale in the Mississippi Valley passes thru Iowa, the localities in which it has establisht itself in the state seem worthy of record. It has so far been found doing injury only in five counties, namely: Decatur, Lee, Louisa, Mahaska and Linn. Only one center of distribution has been found in each of these localities. Four of these counties are south of the 42d parallel; only Linn County being north of it. Four of the outbreaks were in orchards, in all of which some trees were killed. The fifth case was in a nursery in which an isolated block of transplanted trees had been standing for several years, and were found generally infested. Some trees were dying. This block

had been inspected two years before, but no scale had been found, altho the infection must have then existed, as no trees were after that set in the block and the possibility of infection from surrounding territory seemed to be excluded.

In all the above cases, the scale when discovered was in a thriving condition and it was evident that it was only a question of time, unless treatment were given, when the trees would be entirely destroyed. The Decatur County infection was discovered in the early spring of 1901. It was sprayed with whale oil soap in April of that year and with sulfur-lime mixture in the spring of 1902. Complete eradication of the scale, as was proven by annual inspection for four years afterwards, was the result. The Lee County infection was discovered in May, 1906. It was kept fairly well in check during that summer by two sprayings, with a third upon some trees, with kerosene emulsion. It was sprayed in the spring of 1907 with sulfur-lime mixture. The work was done by the owner and, as inspection soon after showed, the trees had not been entirely covered. By autumn many trees were again badly infested. In the spring of 1908 this orchard was again, and this time carefully, sprayed with lime-sulfur. Inspection this autumn (1908) shows that the treatment was not effective in exterminating, altho the number found on any tree that had been sprayed was very small. One peach tree quite distant from the orchard sprayed, and the only tree on the place that had not been treated, was found this fall to be thickly covered with the scale. This tree had been inspected in the spring and no scale found upon it. It seems evident that the sulfur-lime remained upon the sprayed trees in sufficient amounts during a considerable part of the summer to prevent the establishment and rapid multiplication of the scale. The other two cases of orchard infection have been discovered during the present autumn and no treatment has yet been applied. In the case of the nursery, everything found infected and near the infected stock was cut out and burned; and as this nursery had for two years been establishing itself on new grounds several miles away, it is hoped that complete eradication has been accomplished.

Perhaps greater interest attaches to the question as to how certain Iowa grown nursery trees on which the scale has been found became infested. Several shipments from Iowa have been found by inspectors in other states infested with San José scale. In all but two cases, these trees have been traced back and found to have been shipped into Iowa from nurseries in other states. In two cases, however, the trees were grown in large nurseries in the southwestern part of Iowa far removed from any known infestation. In one case a few scattered

scales were found on each of three trees out of a lot of nine hundred shipped to Maryland. The other trees were hand inspected and were apparently clean. Six hundred trees, all of the remainder grown in the block, were subsequently hand inspected by me personally at the nursery in Iowa and no scale discovered. In the other case a single tree was found infected in a large shipment made to New York. The question of the source of this scale is a puzzling one. It seems incredible that it should have been introduced on the scions and not have multiplied more in the three years, during which all the infested trees had been growing in the nursery. On the other hand the orchards for at least a mile in every direction from the nursery have been examined with sufficient care to have insured the discovery of any severe infection.

To summarize, the San José scale has twice been found on Iowa grown trees sent out from the nurseries. Once, in a nursery from which it is improbable any infested trees have been sent out, and in four localities, all in the eastern and southern part of the state, in orchards. In three of these it still exists.

Mr. Washburn: I shall have to criticize Mr. Summers' statement that Iowa represents the most northern spread of the scale in the Mississippi Valley, because it has been known around Madison, Wisconsin, for two or three years, and in South Dakota I heard this winter that the scale had lived through two winters. The stock was burned up the following summer, so we do not know whether it would have gone through another winter or not. It is rather strange, but we have not found it in Minnesota yet. I have no doubt it is pushing its way north, and we have inoculated, in a muslin cage, out of doors, fruit trees with scales that we have had sent to us, and left the top of the cage open during the winter, and have had scales live through last winter. I don't think we ought to regard Iowa as the most northern limit in the Mississippi Valley. I would like to ask Mr. Summers if he has found it around Charles City.

Mr. Summers: We have never found it anywhere except at the places mentioned in my paper.

President Forbes: If there is no further discussion, the next paper will be presented.

Mr. Quaintance gave a brief verbal statement of the facts contained in the paper, which follows:

THE SELF-BOILED LIME-SULFUR MIXTURE AS A SUMMER TREATMENT FOR THE SAN JOSE SCALE

By A. L. Quaintance, *Washington, D. C.*

A self-boiled lime-sulfur wash, that is, one in which the cooking is done entirely by the heat generated by the slaking of the lime, has been for some years more or less used as a substitute for the well-boiled wash for dormant tree treatments for the San José scale. As obviating the necessity for a cooking plant, this self-boiled wash, if effective, would have much to commend it, but unfortunately, in most cases, it has not given satisfactory results in controlling the insect and is, perhaps, now but little used. Analyses of such washes have shown that, as ordinarily made, only a small part of the sulfur present passes into solution, though the free sulfur present is left in a very finely divided condition. The amount of heat generated by the slaking of the lime will vary considerably, depending upon its purity and as to how the mixture is handled, as the use of hot or cold water in slaking, the length of time the mixture is allowed to stand after slaking, whether the vessel be covered, etc. Analyses of washes made in a way to generate and conserve the maximum amount of heat, show that a relatively high percentage of sulfur may be rendered soluble, approximating in fact the amount obtained in a well-cooked wash. Variations in method of preparation, therefore, could well account for the different results reported by orchardists and experimenters in the use of self-boiled washes. The self-boiled caustic-soda wash, quite a different preparation, has been used more successfully as a dormant-tree spray for the San José scale, as the heat from the lime is supplemented by that resulting from the caustic, and the chemical reaction is, furthermore, quite different.

The supposed causticity of self-boiled washes has had the effect of excluding them from among possible sprays for use on trees in foliage and, although these have been much experimented with by entomologists and others, no one apparently has tried a self-boiled wash as a summer treatment for the San José and other scales. The recent investigations of Prof. W. M. Scott, of the Bureau of Plant Industry, of self-boiled lime-sulfur mixtures as fungicides for use on the peach in the control of brown rot and scab, and on apple in the control of scab, bitter rot, etc., have shown, contrary to the general impression, that self-boiled mixtures may be prepared in a way to permit of their use with perfect safety on trees in foliage. This is a very important discovery from the standpoint of plant pathologists, as furnishing a

new fungicide, especially adapted to use on stone fruits, and one of the features of the work, as was pointed out by Mr. Scott, was the probable usefulness of this mixture as a summer spray for the San José scâle.

Unquestionably, the destruction of scale insects may be best accomplished by applications to trees when in a dormant condition, as at this time a very strong wash may be used and there are no leaves to interfere with thorough applications. It often happens, however, that for one reason or another the winter treatments have been neglected or imperfectly accomplished, and the life of the trees will be greatly endangered if the scale is allowed to develop unchecked through a season. Also, the presence of the scale in orchards is often first discovered after the trees have put out foliage and the owner desires to promptly begin remedial work, not waiting until the dormant period of the trees, several months later. For these reasons treatments in summer are often very necessary. Recourse has usually been had to dilute kerosene emulsion, whale-oil soap or other solutions, which, while effectively destroying any crawling lice present at the moment on the trees, have but little effect upon the older individuals or young, which are somewhat protected by the scale covering. The treatment is, therefore, but a temporary check to the insects, and to be of much value in lessening the insects, must be often repeated.

The past summer some tests made under the writer's direction of a self-boiled wash as a treatment for the San José scale seem to indicate that we have in this a valuable addition to our list of scalecides for use on trees in foliage.[1] The experiments were made in two localities, namely, in Maryland, in the vicinity of Washington, by Mr. P. R. Jones, and near Saugatuck, Michigan, by Mr. R. W. Braucher. In the course of some spraying experiments with self-boiled washes for the brown rot of peaches made at Bentonville, Arkansas, in a badly scale-infested orchard, Mr. J. B. Rorer, of the Bureau of Plant Industry, was also able to make some observations on the effect of these treatments upon the San José scale.

The tests made by Mr. Jones on peach at Marshall Hall, Md., while on a small scale, are believed to be quite reliable. Two plats were sprayed just as the young lice were beginning to crawl, and the second plat received an additional treatment about four weeks later. One plat was left unsprayed for comparison. Examinations of the sprayed trees shortly after the first treatment had been made showed

[1]The formula used was that given in Circular No. 1, Bureau of Plant Industry, U. S. Dept. Agriculture, by W. M. Scott.

that there was but little immediate effect on the older scales, though the crawling young and recently set individuals had been killed. Later examinations during the season revealed that, although the adults were alive and actively breeding, but few of the young lice established themselves, owing, no doubt, to the presence of the wash upon the trees. This result is quite in harmony with that well known to result from the use of the well-boiled wash applied in spring shortly before the buds appear; that is, there is a continued effect which is perhaps more important than the direct insecticidal action of the wash. At the final examinations of these plats in the late fall, the condition of trees sprayed once was notably better in regard to freedom from scale than trees not sprayed, and on the plat sprayed twice the scales had been very largely cleared from the trees, approximating in fact a condition resulting from a very thorough use of the well-boiled wash during the dormant period.

In the case of the peach orchard at Bentonville, Arkansas, reported upon by Mr. J. B. Rorer, these trees were very badly infested with the San José scale, many of them being almost completely incrusted. The first application of the wash was made on May 5th, using the formula: lime 15 pounds, sulfur 10 pounds, water 50 gallons; and this formula was again applied on May 21st to supplement the earlier treatment, since this was very imperfectly applied. Another treatment was given June 20th, using the 10–10–50 formula and a final treatment July 9th, using the same strength of wash. This orchard had had no previous attention whatever in regard to controlling the scale, but the treatments very largely cleared the insects from the trees. Many young lice, which continued to develop from the breeding insects present failed to establish themselves, and thus, as the older insects died, the scale gradually disappeared. The unsprayed trees at the close of the season were in a very serious condition. Many of the larger limbs and twigs had been killed and all of the trees greatly enfeebled.

These two instances of the practical cleaning of peach trees of scale, in view of the serious infestation which existed, are considered very favorable to the usefulness of the wash as a summer spray, especially since it will doubtless come into extended use in the control of fungous diseases, as already mentioned. In the case of peach, it seems probable that when used as a fungicide for peach scab and brown rot, it will at the same time sufficiently destroy the scale as to obviate the necessity of the usual dormant-tree treatment. Great thoroughness in applications, however, would be necessary, reaching the body, limbs and twigs.

In the tests in Michigan, carried out on apple by Mr. Braucher, it was planned to determine to what extent summer applications of the wash would prevent the young lice from settling upon the fruit when used supplementary to the usual dormant treatment, and when used as a summer spray only, as might occur in its use as a fungicide. Several things interfered to prevent the execution of the work as planned and the results were variable. The importance of the dormant treatment, however, was clearly shown, and also of a summer treatment about as the young scales were due to appear from adults which escaped destruction, for protecting the fruit from spotting.

The principal reason for presenting this brief note is to call the attention of entomologists to the possibilities of using the self-boiled lime-sulfur mixture as a summer spray for the San José scale, so that if desirable it may be tested under a wider range of conditions.

The question naturally arises as to the effect of the addition to the wash of arsenicals, such as arsenate of lead, or Paris green, necessary especially in the case of the apple. When the former is added to the wash important evident chemical changes result, the wash taking on a dark gray or blackish color. Concerning these reactions, Mr. J. K. Haywood of the Bureau of Chemistry, to whom we submitted the question, says: "First, in regard to mixing lead arsenate with lime-sulfur: the lead arsenate is decomposed to a certain extent, lead sulphide and calcium arsenate being formed. The latter is somewhat soluble, unless an excess of lime is present, in which case it is rendered insoluble. The lead sulphide formed being insoluble, would remove some of the sulfur from the solution, but this amount would be relatively small and would probably not materially lessen its efficiency.

"In the case of Paris green and lime-sulfur, the former appears to be entirely broken up, some of the arsenic going into solution, as arsenic sulphide. A part of the copper also goes into solution, the remainder being precipitated as sulphide. The presence of an excess of lime in this case does not entirely render the arsenic insoluble. The latter practice, therefore, would seem to be of doubtful expediency."

President Forbes: This paper is now open for discussion.

Mr. Parrott: I am very glad to hear the results secured by Mr. Quaintance, because we have had similar results in our experiments with this mixture. We have also found that it is very effective in controlling the brown rot on sweet cherries. A number of fruit growers in New York have tried this spray and, while it did not cause any

injury in our experiments, there is one orchardist who states that it injured the foliage of peach trees. I would like to ask if this wash is uniformly safe.

Mr. Quaintance: I would say that it differs a good deal, according to the manner in which it is prepared. I see Mr. Scott in the audience, and I would like to ask him to state his experience in preparing it.

Mr. Scott: In the experiments that we made in 1907, this wash caused no injury to peach foliage and we were greatly surprised at the results. They were published with some "fear and trembling" in Circular No. 1 of the Bureau of Plant Industry. When we began work again last spring we made a foliage test, using mixtures made in various ways, and found that by using boiling water and allowing the hot mass to stand for thirty or forty minutes, the cooking continued and a large per cent of the sulfur combined with the lime. By slacking the lime with cold water and, as soon as the violent boiling ceased, adding more cold water to reduce the temperature and thus prevent further chemical action, we secured a mixture which was not injurious to peaches or apples. The point is to stop the cooking process immediately after the lime is thoroughly slacked.

As to the strength, we used 10 pounds of lime and 10 pounds of sulfur to fifty gallons of water and secured good results against the peach scab and fairly good results against brown rot. We found that by diluting the mixture down to 6–6–50, the results were not quite as good.

Mr. Gossard: If it is not getting too far away from the subject, I would like to ask whether there has been any experiments tried in combining arsenate of lead with the self-boiled lime-sulfur wash? One or two fruit growers wrote me that they had had a rather disastrous experience in this connection. I made some experiments on apple, but used the two washes separately. This treatment controlled scab about as well as Bordeaux mixture, but it did not entirely control apple scab in Ohio this year. I would like to know if these two insecticides can be safely mixed.

Mr. Braucher: I had a similar experience in my work in Michigan. After the trees had been sprayed with Bordeaux mixture and then sprayed with the self-boiled lime-sulfur wash there was a decided change. The leaves became a russet brown and looked as though they were very badly injured, but later observations showed that there was no special injury to the foliage. I tested that point in the laboratory by taking some lime-sulfur mixture and adding arsenate of lead to it; by adding sufficient arsenate of lead I took

every bit of color out of the lime-sulfur mixture and a slate colored precipitate was thrown down, showing that there is a pronounced chemical reaction. I do not consider it a safe mixture to use.

MR. QUAINTANCE: Mr. Haywood of the Bureau of Chemistry made an analysis for us and found that the arsenate of lead, when added to the self-boiled wash was changed. Lead sulfide is formed and arsenate of lime. The arsenical is present in the form of arsenate of lime and, of course, might do considerable damage, as there might be more or less uncombined arsenic. Paris green has also been used in combination with the wash. Mr. Scott had some tests of these combined sprays under way in the Ozarks, and I saw the plats myself, and we were not able to detect the slightest injury.

PRESIDENT FORBES: The next paper will be presented by Mr. Sanderson.

NOTES ON RECENT EXPERIMENTS FOR THE CONTROL OF THE CODLING MOTH

By E. DWIGHT SANDERSON, *Durham, N. H.*

Investigations of the life history of the Codling Moth in 1908 add little that is essentially new to the results given this association last year.[1]

Experiments concerning the time and method of spraying have, however, more fully confirmed our previous work and we feel we have established certain points which need emphasis. The results of three years' work also show the necessity for the most careful arrangement of plots and recording of data in order to secure definite results. The details of our results will not be given here, but can be studied in the forthcoming 20th Report of the New Hampshire Agricultural Experiment Station.

1. **Time of Spraying.**—All experiments have shown the first spraying just after the petals fall to be the most efficient, giving an average benefit of 82% when used alone.

Formerly we were advised to spray a week or two after this. Under some climatic conditions this may be advisable, but there is little reason for an application for the Codling Moth in New England at that time. The second spraying should be applied when the eggs are hatching, three or four weeks after the first spraying. An average of five plots given this spraying only show 72% benefit for the season. Recently there has been a tendency to magnify the value of thorough

[1]Journal of Economic Entomology. I, 129–140.

work with the first spraying and to depreciate the value of later spraying if the first was properly made. In reviewing the records of previous experiments the writer has been unable to find any satisfactory experiments to show the value of a single spraying when the eggs are hatching. Our work has been carried on on so large a scale, however, that there seems to be no doubt of the value of a single spraying at this time. Observations of practical men confirm this. Mr. H. L. Frost advises me that he has frequently observed orchards sprayed for gypsy moth in late June and early July, which showed practically no wormy fruit as a result of this one spraying. The fruit grower should not be encouraged to neglect the more important spraying when the petals drop, but he should know that if for any reason he is unable to spray then that a thorough spraying three or four weeks later will save nearly three fourths of his loss from worminess.

Several experiments have previously indicated this, but the data was inconclusive. Thus Cordley in 1902[2] showed that where the check tree had 20% wormy, trees given the "2d, 3d and 4th" sprayings, the first being omitted, had but 5% wormy, while those which had the first spraying also had but 3% wormy. Green and Houser in 1905[3] show that in one orchard where 56% of the picked fruit was wormy on unsprayed trees but 11% was wormy where spraying was given only in July and August, against 5% wormy where six sprayings were given in June, July and August. In another orchard, where 52% of the checks were wormy when picked, but 5½% were wormy in trees sprayed June 22d and July 16th, while those given two previous sprayings had only 3% wormy. These results, however, are conflicting and the methods employed were hardly accurate enough to be conclusive.

Recently Gossard[4] found that where unsprayed trees had 46% wormy, spraying when eggs were hatching gave practically 12% wormy, while the first spraying alone gave 6½% wormy. Observation has shown that the eggs are laid on all parts of the foliage, that the newly hatched larvæ feed on the foliage, and that many enter the calyx by eating directly through the calyx lobes, upon the outside of which a large amount of poison is always lodged. It is evident, therefore, both from our knowledge of the habits of the insect and from the direct results of experiments, that spraying when the eggs are hatching so as to cover the foliage and fruit is of great value and should not be neglected.

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[2]Bulletin 69. Ore. Agr. Exp. Sta., p. 150.
[3]Bulletin 160. Ohio Agr. Exp. Sta., pp. 205–208.
[4]Bulletin 191. Ohio Agr. Exp. Sta., p. 116.

2. **Method of Spraying.**—Further experiments have but confirmed our previous assertion that in New England a drenching spray, as advised by some western entomologists, is of no value as far as driving the spray into the calyx is concerned. The reason is not far to seek if the apples are studied. Professor Slingerland[5] has recently shown that the calyces of apples may be closed before the stamen bars are sufficiently shrivelled to allow the spray to penetrate to the lower calyx cavity. Many careful examinations of Baldwin apples have shown this to be absolutely true of that variety under our climate. All of our experiments have been made on the Baldwin, as it is practically the only commercial variety in Northern New England. Our heavy spraying was done this year with Bordeaux nozzles at an angle, at 100 to 120 lbs. pressure, with a gas sprayer, and yet we were unable to find the slightest of spray in the lower calyx cup.

Where the calyx lobes remain open long enough to permit spraying between them after the stamen bars commence to shrivel, there can be no doubt that it is the desirable time to spray and that the spray should be shot into the lower calyx cavity, but that such a spraying is so all-efficient as recently claimed seems hardly to be demonstrated by the evidence submitted. There are also striking differences in the methods used to reach the lower calyx cavity by the chief advocates of its use. In his first publication[6] Ball tells us that a barrel pump giving 85 pounds pressure enabled him to place the poison in the lower calyx, and later[7] he states that a pressure of 85 to 120 pounds is correct. But Melander[8] insists that 150 to 200 pounds pressure is necessary and scouts the idea that satisfactory work can be done with 85 pounds pressure, referring to the work of Doyd in Illinois.[9]

The value of driving the spray into the lower calyx cup was first suggested by Ball in 1904. In Bulletin 95 of the Utah Station he describes the method used and in the summary states:

"To get the best results from early sprays they must be applied in the form of fine drops driven with force straight into the bottom of the calyx cups." No experiments are recorded, however, in which this method is compared with an ordinary mist spray thoroughly applied. Nor has he later described any experiments to prove the superior value of such a method of spraying. The value of such spraying seems to be based on the belief that most of the young larvæ are

[5]Journal of Economic Entomology. 1:352.

[6]Bulletin 95. Utah Agr. Exp. Sta.

[7]Bulletin 67. Bureau of Entomology, p. 63.

[8]Popular Bulletins. 5. Wash. Agr. Exp. Sta., p. 5.

[9]Bulletin 114. Ill. Agr. Exp. Sta.

killed by eating the poison in the lower calyx cup, because dead larvæ were frequently found in the lower cavity and never in the upper cavity.[10]

Is there any reason why a larva may not have eaten the poison in the upper calyx cavity or when eating through a sepal into the lower calyx cavity, and then died in the lower cavity? Because poison is placed in the lower cavity and dead worms are found there is but circumstantial evidence that the larvæ are killed there. If so, how do we secure equally good results in New England, where it is impossible to spray into the lower calyx cavity? In his later paper Ball describes experiments made in 1905 (*l. c.*, p. 57, 59) in which plots were sprayed with the first, second and third spraying separately and in combination. "The first spraying was applied just after the blossoms fell, the second ten days later, and the third fifteen days after that." With the second spraying only 76% of the first brood of larvæ were killed and 31% of the second brood; and with the first spraying only 83% of the first brood and 39% of the second brood. In other words the second spraying alone was about 7% less efficient than the first. Later (*l. c.*, p. 70) he states that about ten days after the blossoms fall the stamens have shrivelled and that then is the best time to spray. (See *l. c.*, fig. 4.) The plots given the second spraying only were sprayed just ten days after the blossoms fell and, therefore, just at the best time, but they show 7% less benefit than those sprayed just after the blossoms fell. This difference is even more striking in his results in 1906 (*l. c.*, p. 66), when the second spray gave but 64% killed in the first brood and 38% in the second brood, while the first spraying alone gave 84% and 57%. Strange enough, however, the first and second together were poorer than the first alone, killing but 72% of the first and 57% of the second broods. There may have been some circumstances concerning these experiments not described by the writer, but the data submitted hardly seems to demonstrate the necessity of reaching the lower calyx cavity.

More recently Melander[11] has made the statement: "We have shown that the first spraying *can* be so thoroughly applied that other sprayings are hardly necessary." Just how this was "shown" we are unable to determine, as every plot described in the bulletin had from two to four sprayings. Nor do we find described any direct comparisons to show the difference in the same orchard between trees sprayed with the "old-fashioned" and "up-to-date" methods. On the other

[10] Bulletin 67, Bureau of Entomology, p. 73.

[11] Bulletin 86. Wash. Agr. Exp. Sta., p. 15.

hand, the unsprayed trees in one orchard (*l. c.*, p. 15) had 74% and 95% good apples. Surely, it does not take extraordinary spraying to secure 100% perfect fruit where 95% are perfect on unsprayed trees. In the orchard showing the most perfect fruit four sprayings were given, but there were no check trees left unsprayed. So far as we can ascertain, this is the evidence by which the supreme efficacy of the new methods is "shown." In 1907, however, Melander and Jerme[12] give the results of spraying sixty-three trees with various brands of arsenate of lead in an orchard in which the unsprayed trees had but 42% good fruit. The trees sprayed four times had an average of 96.5% good fruit. A power sprayer and Bordeaux nozzles were used in 1907, but nothing is said about the efficacy of thorough work at the time of the first spraying. However, 96.5% good fruit were secured against 98% in 1908, and the 1907 records are certainly much more accurately given. Furthermore, in one plot in 1907 the fourth spraying was omitted and gave but 84% good fruit, though it had the first three sprayings. Concerning this Melander and Jerme there remark: "The greatly increased percentage of worms in these trees clearly shows the necessity for this last spraying, which must be given for success," which conclusion is based on much better evidence than that offered in 1908, to show that it is *not* necessary. Also in Bulletin 77 of the Washington Station (p. 64) Melander and Jerme have shown that fairly good results were secured when the first spraying was omitted in an orchard where 56% was wormy on unsprayed trees.

The writer does not wish to be understood as disbelieving in the value of driving the first spray into the lower calyx cavity, where varieties and climate make such a method possible, but he does wish to see some experimental evidence which will fairly demonstrate the desirability of such spraying, and particularly to support the claim that one thorough spraying with but one pound of arsenate of lead per barrel is sufficient, if rightly applied, when the evidence submitted goes to show the great value or necessity of also spraying the foliage and apples, in addition to the spray in the calyx in order to satisfactorily control the Codling Moth.

3. **Method of Experimentation.**—Several years ago[13] the writer showed the absolute necessity of treating several trees alike in order to get an average upon which a comparison of different treatments might be made, on account of the variation in individual trees treated alike. Yet experimenters have gone on counting but one or two trees

[12]Bulletin 81. Wash. Agr. Exp. Sta., p. 6.

[13]Delaware Agr. Exp. Sta. 13th Rept., Table VII.

and ask us to give credence to their conclusions. Our recent experiments have even more strikingly shown this, and in his report the writer has taken space to give the complete records of all the plots sprayed the last three years. The variation between trees side by side in the center of large plots is so considerable that the utter futility of experiments with but one or two trees in a plot is at once apparent. This is strikingly shown in the work of Lloyd (*l. c.*, 388, 390), in which for two years eleven trees were treated in as many ways and the percentage of wormy fruit was greater where two heavy applications were given than but one application in both years.

Our records also show the necessity of comparing results in percentages rather than by the number of wormy apples, unless the trees are all of uniform size, evenly fruited, regularly placed, and bearing the same year.

The arrangement of plots must also receive more careful consideration. Unsprayed check trees must be isolated and yet of sufficient number to represent the orchard. The plots must be large enough so that the central trees in each will not be materially influenced by the next plot. In our own experiments we have endeavored to determine the proportion of larvæ killed in the calyx by eating the side of the apple and by eating the foliage, and we have secured considerable evidence on these points. But we have been forced to the conclusions that the orchards available are too small and are not uniform enough to secure comparable results. Our records will be found to be filled with inexplicable inconsistencies and contradictions, which can be due to nothing else than the lack of uniformity in the trees, as regards the year bearing, number of fruits borne and position. To determine such points or the influence of any given spray on the first and second brood, a large orchard is needed, all the trees of the same variety, or of but few similar varieties, with plots of each variety treated similarly, so that their similarity may be determined by the comparison of those treated the same. The trees should all bear uniformly as to number of fruit and the year bearing. The plots should contain 21, or preferably 35, trees and the fruit from five central trees should be counted, both windfalls and picked fruit. As orchards offering such conditions are not available in New Hampshire, we have been compelled to forego further investigation of these problems.

If we are to secure any results upon problems of this kind which are at all conclusive and which will not be as readily contradicted, we must arrange our experiments on a larger scale and with greater exactions and care. The conditions surrounding such biological problems are so varied that too great care cannot be taken in arranging

different plots which are to be compared. Experiments in the control of the Codling Moth have now been made for a quarter century, at a large cost, yet many of the most elementary matters concerning the effect of such treatment are still unsolved. Unless more careful and elaborate methods of experimentation are adopted, they will remain befogged by the mass of data based on single trees and "sample counts," while time and money are being wasted without adding to our knowledge.

At the present time, when increased emphasis is being placed upon agricultural research of a high order, we must see to it that the methods we employ are of as undoubted scientific accuracy and thoroughness as possible. Otherwise we need not complain if funds for investigation are given to investigators in other sciences in which better methods have been developed, whereby more accurate and incontestable results can be secured. Let us give more attention to our methods of work and let us remain agnostic until we have secured such a mass of conclusive evidence as will enable us to definitely establish the facts. By so doing we will avoid burdening each other and the public with opinions, so many of which have in the past been quickly refuted, and which tend to lessen confidence not only in the individual investigator, but in the science he represents.

President Forbes: Discussion of this paper is now in order.

Mr. Taylor: Mr. President, I am more or less familiar with the methods of Codling Moth spraying in the West, and also in the East, having had some experience in fighting this insect in Colorado and in the Ozark district in Missouri, and I must say that the difference of opinion that has sprung up between eastern and western methods is somewhat exaggerated. After all, I don't think there is such a difference in conditions between the West and the East, and I believe that the principal difference in opinion is not so much a difference in the entomological value of the sprays as it is a matter of expediency in applying them. For instance, the people of the West who are equipped with power sprayers contend that the spraying with power outfits at a high pressure is much better than spraying with barrel pumps, with pressures of 100 or 125 pounds. In an experiment that I conducted in the Grand Valley in western Colorado with a power outfit we sprayed a row of trees at 100 pounds pressure and on the next row we used 180 or 200 pounds. We found that we sprayed more trees with the high pressure and that we sprayed out our tank in a much shorter time. That is the point that the orchardist is after. He wants to get his work done quickly and spray as many trees as possible. I think that

all of you who have had experience with power sprayers will agree with me in this respect.

As to the value of early sprays, Mr. Sanderson has mentioned controlling the Codling Moth by omitting the first spray. I am certainly of the opinion that the western people have the right idea in placing great value and importance on the first spray, the one given immediately following the dropping of the petals. This year I applied the methods followed in the West in an apple orchard of about 1,500 trees in the Ozarks. I applied three sprays, the first of which I gave immediately following the dropping of the petals, but before the calyx lobes had closed, in a drenching spray. I applied two lighter sprays, using a fine mist, which was used so as to leave a maximum amount of the material coated over the apples. I do not believe, from my experience, that a single spraying will control the Codling Moth in apple orchards where the infestation is severe. I do not think that is possible, from the fact that according to counts made by me while in the western Colorado section they showed that about two thirds of the worms entered the calyx end and about one third at the side of the apple, and any spray applied so as to fill the calyx only, whether in the upper calyx or the lower, would not destroy the 33% that might enter the side of the apple. I think that the better orchardists in the West are coming to this plan of applying the first spray with a heavy drenching spray after the dropping of the petals, and using later a fine mist spray. I produced this year, out of a count of some four thousand apples, only six infested with Codling Moth, and that was in Missouri, a result, I think, which will compare favorably with any shown in the Northwest. After all, if the entomologists of the West and Northwest could come to our meetings and talk this matter over, there would be fewer chances for such differences of opinion as seem to have arisen.

PRESIDENT FORBES: The next paper on the program is by Mr. E. D. Ball, Logan, Utah.

IS ARSENICAL SPRAYING KILLING OUR FRUIT TREES?

By E. D. BALL, *Logan, Utah*

In Bulletin 131 of the Colorado Experiment Station, Dr. Wm. P. Headden comes to some very startling conclusions with reference to the effect of continued arsenical spraying on the life of our orchards. As the truth or falsity of these conclusions is a matter of vital and immediate importance to the fruit growers of the West, if not to those

of the whole country, it is important that every fact bearing on the case should be made known at once.

Briefly summarized, the bulletin sets forth that the apple trees in the Grand Junction District of Colorado are affected with certain troubles, which Mr. Whipple in Colorado Bulletin 118 calls "root rot," and divides into two classes. One of these troubles Mr. Whipple dismisses with this statement: One form, which is proving the least destructive of the two, seems to show no preference for varieties, and confines itself to that part of the tree below the ground." The other condition described by Mr. Whipple at some length is apparently our old friend, long and widely known as "collar rot." He says, "It works exclusively on the Ben Davis and Gano," and describes the dead areas of bark, the girdling of the crown, the early ripening of the foliage and other characters well known as characteristic of this condition.

Doctor Headden, who had previously predicted that arsenical spraying would be dangerous, made a trip to this section late the next season and was shown a tree, one side of which had been killed by dumping the soluble arsenite of soda into a ditch, from which that side of the tree received its water. From this tree the doctor took samples of the root, trunk and branches and on analysis found that they contained arsenic. He afterwards collected samples of thirteen other trees that were dead or dying from the "root rot" conditions described above and on examination found arsenic present in each one of them. He also examined the soil under some of these trees and found arsenic present in considerable amounts but in an insoluble form. As the result of these tests the doctor comes to the following conclusions, which I quote:

"I regret that I can see no other conclusion than that the corroding of the crowns, the killing of the bark, the staining and final destruction of the woody fibers, the early dropping of the leaves, presaging the early death of the tree and its final death a few months later, are caused by arsenical poisoning."

Doctor Headden in this statement is talking about conditions which he states he observed "from near Fruita, almost to Palisade, and in the neighborhood of Delta," and which he believes already involves the principal apple-growing sections of Colorado and of which he says: "It is also true that literally hundreds of trees have already died or are sick."

If Doctor Headden is right in his conclusions as to the cause of the death of those "hundreds of trees," he has given us a warning, which, if heeded in time, will prevent a course being pursued by the fruit

growers of the West, which would have caused millions of dollars of loss in ruined orchards. If, on the other hand, he is mistaken in his conclusions, the publication is most unfortunate, as it will, no doubt, cause a decided reaction against a now highly successful method of spraying and bring consequent financial loss to the fruit industry.

It might be well to state in this connection that Doctor Headden is a well known and thoroughly reliable chemist, and there is no reason to doubt the absolute accuracy of any of his chemical findings. He is not, however, a horticulturist or a plant pathologist, and has taken little interest in orcharding, and his conclusion that the trees he found dying or dead in other orchards were affected in the same way as the ones known to have been killed by the soluble arsenic is open to serious question. He places a great deal of weight on the similarity in appearance of the bark and the discoloration of the heart wood, as illustrated by his figures, but as far as anyone can discover from the statements of the bulletin, he made no examination of the apparently healthly trees in these same orchards nor of dead trees in orchards that had not been treated with arsenical sprays. In fact, nowhere in the bulletin can we find a statement that would lead us to believe that he is aware of any cases of trees dying where no arsenical sprays have been used.

Alkaline Ground Water Killing Trees

In investigating orchard conditions in Colorado and Utah the writer has had frequent occasion to study both conditions described by Mr. Whipple. The condition first mentioned, in which there is no preference for varieties, has destroyed several hundred acres of orchards in Utah and western Colorado, and in every instance where this has been investigated it has been found that the ground water was very close to the surface, or at least came up during some part of the year, and contained a large percentage of alkali.

In one section, where the greatest loss has occurred, a survey of the region, showing the depth of the ground water, has been made and in every case the worst affected orchards are located in the region where the water is closest to the surface, as shown by this map. Over one half of the orchards in this section had never been sprayed and in others many trees died before they were large enough to bear fruit. In other cases trees are dying from alkali, where the ground water is not normally close to the surface but where at certain seasons of the year irrigation on the higher lands brings it up temporarily.

Where the ground water is constantly close to the surface young trees grow with great vigor until the roots reach this standing water, and then they gradually become sickly and yellow, the leaves ripen

prematurely and as the trouble progresses the bark becomes mottled and discolored with brown areas and the trees gradually die. In cases where the ground water fluctuates through irrigation, the tree may be growing in an apparently healthy and vigorous manner one day, by the next the leaves may begin to show brown upon the edges, and in a few days the entire foliage will look as if it had been sprayed with some soluble arsenical solution. If the ground water remains close to the surface for some time the bark will become mottled and the trees will die. If it soon falls they will often drop their burned leaves and, if not too late in the season, the young shoots will push out and form a partial green covering again. This occurrence is so common in some of the low lying districts adjacent to the Great Salt Lake, where it is impossible to drain, that it occasions little comment, everyone understanding the conditions that produce it.

On the Central Utah Experiment Station an orchard was planted just below an irrigated bench, or table land, and the seepage water from the side of this bench rendered the upper end of the orchard almost impassable, and the trees gradually died. A trench was dug to intercept this alkaline water, after which the ground below the trench dried up, the remaining trees recovered and the orchard was apparently saved. A year later a cave occurred in the trench and the water began to rise again. Within a few days the trees in this area were brown and scorched, as if swept by a fire. The trench was then cleaned and repaired, the water soon subsided in the orchard and all the trees except one put forth a new crop of leaves. No arsenical spray had ever been applied to this orchard until after the trees died.

Conditions similar to this exist throughout the lower and heavier land between Fruita and Palisade, where not only the fruit trees have died, as cited by Doctor Headden, but a part of the farm land has been ruined by the alkali rising. Some of the orchards in this section were badly affected before they were sprayed and none of the farm land has had any arsenicals applied at any time.

Many other specific instances could be cited of orchards that have been badly affected, or even entirely ruined, where no arsenical spraying has ever been done, but it does not seem necessary. The above facts seem to the writer to be sufficient to warrant the conclusion that it is impossible to identify this condition with any effect of arsenical sprays.

"Collar Rot" Killing Trees

The second condition described in the Colorado Bulletin is commonly recognized throughout the United States under the name of "collar rot," and apparently confines itself largely to the Ben Davis

apple, sometimes attacking the Gano and only rarely any other sort. In three or four places in Utah this disease has been alarmingly abundant. Mr. Lars Nording of Hyrum, Utah, planted Ben Davis and Johnathan alternately in the rows in the orchard. Within three years the Ben Davis began to die of "collar rot" and continued to die in this way, until now they are nearly gone, while none of the original Johnathan, nor those planted in the place of the dead Ben Davis, have been affected. No spraying was done in this orchard until nearly half of the Ben Davis trees were dead, and they have not died more rapidly since spraying commenced.

When the writer began his spraying experiments on the orchard of Mr. Smart a number of trees were found dead or dying of "collar rot," although the orchard had never been sprayed. These trees were all in a small section of the orchard and in this section other trees have died since the spraying was carried on, while the rest of the orchard has not been affected.

At Morgan, which is situated in a high mountain valley, a large number of Ben Davis were planted a few years ago, and before any of these orchards began bearing, and therefore before spraying had commenced, numerous complaints were made of the loss to their trees through this disease. The Central Experiment Station orchard contains about two acres of Ben Davis trees and when the first spraying was applied there were a number of trees dead and others dying of "collar rot."

The writer is fairly familiar with most of the orchard regions of both Colorado and Utah and has visited many of the sections of the Northwest, and in no case has he observed that there was any more loss from these causes in orchards that had been cared for and sprayed for years than in neglected and unsprayed orchards, which should, if Doctor Headden's conclusions are correct, be immune from these troubles.

The only conclusion that it seems possible to draw from the facts cited is, that arsenical poisoning cannot be the primary cause of either one of the above described conditions, and that therefore the main conclusion of Colorado Bulletin No. 131 is unwarranted. In this bulletin a third condition is mentioned, as occurring in a few cases, in which the sap oozes from the trees and forms a gummy or crystalline mass. This condition the writer has never seen and is therefore in no position to discuss.

It should be borne in mind in this connection that Doctor Headden was handicapped in his studies by the fact that the area under investigation is located several hundred miles from his laboratory, where

most of the work was done, and that his work in the field was therefore limited to one or two hasty trips. It is also well to remember that no experiments were carried on on fruit trees, the only attempt to test the effect of arsenic being made on green-house plants, and that the only trees known to have died from arsenical poisoning were the two that were killed by the soluble arsenite of soda, which we know would have killed them immediately if it had been sprayed on the foliage.

Mr. Carpenter, a former resident of this valley, is authority for the statement that the waters of the Grand River carry a considerable amount of soluble arsenic, received from the washings of mines and smelters located upon its head waters, and that at the present time arsenic can be found in all the soils of the lower end of the valley. This may possibly be the source of some of the arsenic found by Doctor Headden, rather than from the insoluble compounds used in spraying.

Where the Bulletin is Valuable

This bulletin, if rightly interpreted, contains considerable of value to the fruit grower. This interpretation, however, will be one of very guarded warning against intemperate and excessive as well as needless use of arsenicals. Thus construed it will only serve to strengthen the position taken by those who are urging the use of the new methods in spraying, worked out by the Utah Experiment Station and later confirmed by other workers. For in these experiments it has been abundantly proven that one single driving spray, if applied at the right time and in the right way, will do more to protect an orchard for the entire season than half a dozen sprayings in the old way.

Doctor Headden shows in his bulletin that even a small amount of ordinary alkali, or even of common salt alone, in the water will serve to render some of the arsenic of a spraying solution soluble, which serves to explain a number of things that have happened in Utah in the past. In one case an orchardist sprayed his entire orchard with Paris green and practically ruined his crop by burning, while his neighbors used the same brand of poison without serious injury. This particular orchardist, however, undoubtedly used strongly alkaline water from a surface well, while his neighbors took their water from an irrigation ditch.

In another case an orchardist used an approved brand of lead arsenate in spraying and killed everything that he touched with it. It was only a small job and it seems probable that the barrel used had formerly contained salt or brine.

This bulletin will also serve as a warning to those contemplating

planting trees in a strongly alkaline soil, even where the ground water is not ordinarily close enough to be considered dangerous, for if the rising alkali is capable of freeing the arsenic, it would not be very long before the soil would be so impregnated that it would not only kill the trees but render the ground unfit for any other crop.

The entire matter is one that calls for careful and exhaustive investigation and for cautious and guarded statements of any kind until the results of these investigations are known. Hasty and ill-advised statements with reference to the purity of arsenicals have already done a great injury to the fruit industry in the intermountain region.

Conclusions

1. That the conditions described by Doctor Headden and attributed to the effects of arsenical spraying occur over widely distributed areas and have killed thousands of trees on which no arsenic has ever been used, and that therefore arsenical poisoning cannot be the primary cause of this trouble.
2. That the only trees positively known to have died of arsenical poisoning were the two to which a soluble arsenite was applied, a compound which no one has ever used for spraying purposes.
3. That the entire subject of arsenical poisoning is a matter for careful and exhaustive investigation and that any statements preceding that investigation should be of the most guarded nature.
4. That there is a possible danger in the use of even slightly alkaline waters in the application of spraying materials, and that there is a probability of danger from excessive spraying on strongly alkaline soils.
5. That those who are using the driving spray or contemplate using it may do so with the assurance that they are using the most effective and at the same time the least dangerous method possible,—if there should prove to be danger in arsenical spraying,—and that the best and most productive orchards in the West are the ones that have been the longest sprayed.

The following paper was briefly summarized by the author:

THE ALFALFA LEAF-WEEVIL

By E. G. Titus, *Logan, Utah*

For the past six years the alfalfa-growing territory in the vicinity of Salt Lake City, Utah, has been suffering from the attack of an

insect that is constantly increasing in numbers and continually widening its zone of injury.

Thorough examination of the surrounding region, especial attention being paid to native food plants, disclosed no attack upon these by this insect and I became convinced that the species was an introduced one. Mr. E. A. Schwarz recently examined specimens I brought to him and determined the species as *Phytonomus murinus* Fab., a European species not hitherto reported in this country. A single specimen had previously been determined by Mr. Schwarz as *P. castor* Leconte.[1] While we have not had the opportunity to compare the specimens with Leconte's type, his description so closely fits the European specimens and the Utah species that there seems to be no doubt but that we here have another instance of a species described from a wrongly assigned locality, Doctor Leconte giving "Canada" as the habitat, while the probabilities are strong that his specimen was of European origin.[2]

In Europe this species has long been known as a serious pest to alfalfa[3] and its advent into the western continent is of considerable importance, the number of insects already attacking the alfalfa being sufficient to make the question more than interesting to both the farmer and the entomologist.

The earliest definite report of injury in Utah that I have been able to trace is one that occurred in the spring of 1904, on a farm on the east side of Salt Lake City. Several acres of alfalfa in one field were at that time seriously injured, the first crop being one half lost and the second crop practically destroyed. While this was evidently the first serious loss, it should be considered that it must have taken several years for the insect to multiply in sufficient numbers to cause such an appreciable injury to the crop.

Distribution

The zone of injured fields has been constantly increasing, until at the present time it is known to occur from the hills northeast of the city to some distance south of the town of Sandy and eastward to the foothills. The western edge of the infestation until the past two years seemed to be the railroad lines running south from Salt Lake City. It has now passed this barrier and spread for some three miles westward along one line and a mile in another place. This makes a total area of almost 100 square miles of territory, in which there is probably grown about 2,500 acres of alfalfa. The extension to the west

[1]1876: Leconte; The Rhynchophora of America, North of Mexico (Proc. Am. Philos. Soc. XV, Dec., No. 96, p. 126).

[2]1882: Riley; Report 1, Entomologist. U. S. D. A., p. 172.

[3]1848: Heeger; Isis, p. 980.

side of the railroad opens to its invasion a considerable number of very fine fields and will give the weevil an opportunity to work southward, onto some of the most fertile farming land in the state. The alfalfa raised in Salt Lake County is nearly or quite all used in the county, so that one serious means of spreading the insect is almost obviated. Where animals are being shipped from the county, for instance at the time of such events as the State Fair, abundant opportunity may be given for the insect to pass to some other uninfested district or even out of the state. Many of the fruit orchards are surrounded on one or more sides by alfalfa fields and the migrating weevils have been found concealed in fruit packages. The principal means of distribution of the weevil at the present time is that of migration by the adults in the summer and fall.

Life-History and Habits

The egg-laying period lasts for several weeks, due apparently to the long period over which adults are emerging from hibernation. The eggs are laid on the plant, and most of those found have been in or near the growing tips. The eggs are oval, pale yellow, .2 mm. long, darkening to a greenish yellow before hatching. I have reason to believe that some of the weevils lay some eggs in the fall near the ground on the stems.

The young larvæ are pale green, changing after their first meal to a green slightly paler than that of the leaves on which they feed. The color is so deceptive that unless larvæ are numerous it often takes considerable searching to locate them. When two thirds or more grown they are more easily seen. Usually while feeding the anal end is curled around a part of the leaf or bud in the same manner as in some other species of the genus. At this age they are easily disturbed and often fall to the ground before the plant has been touched. There are at least four distinct stages in the life of the larva, each lasting from eight to ten days. The full-grown larva is 4 to 6 mm. long and has a distinct broad white dorsal stripe.

The full-grown larva drops to the ground and among the fallen leaves or at the base of the stems spins an open-work lace cocoon much finer than the case of *P. punctatus*. After several days, depending somewhat on the weather, a greenish white pupa is formed and in from 10 to 14 days the adult weevil appears. After two or three days it hardens, turns brown, and then cuts its way out of the cocoon, crawls up a stem and begins feeding.

The beetle varies from 4 mm. long in the male to 5 or 5.5 mm. in the female. When freshly emerged they are brown with a distinct darker

line extending centrally down the elytra. Head and pronotum are finely, closely pubescent with gray hair, that on the head sometimes extending quite to the tip of the beak; prothorax slightly longer than wide, narrower in front than behind, widest in the middle, rounded on the sides and densely finely punctured. There are two longitudinal stripes of brown hairs or rather fine scales, separated in the middle by a narrow gray line; the sides of the prothorax are covered with dense gray hairs; elytra ⅓ wider than the prothorax, oval, but with sides nearly parallel, humeri rounded, the striæ are distinctly punctured. The elytra have rows of fine gray setæ alternating with hair-like scales (each scale being deeply cleft so that it appears as two hairs); there are some fine darker hairs present in such a manner as to present small spots of black. Antennæ with first funicle joint much longer than second; last joint of funiculus separated from club. Legs dark brown with numerous gray hairs present on the femora and tibiæ, tarsi more sparsely pubescent; antennæ slightly pubescent.

After a short time many of the specimens lose considerable pubescence and appear very dark or even quite black, almost giving the appearance of two species present in the field. The males are slightly narrower than the females in proportion to their size.

All stages of the larvæ, the cocoons and fully developed beetles, have been found in one field during the latter part of June and throughout July. Larvæ not half grown have been taken on September 14. These probably were belated larvæ that had failed to develop as rapidly as the others, since there is no present evidence of there being more than one brood of the weevil.

A large percentage of the weevils soon begin to migrate, moving in almost every direction from the field. I have been told that in the late fall, on very warm days, they have been seen flying, but so far I have been unable to get one to fly, nor have I seen any on the wing. They are strong walkers, untiring and steady. I have found them scattered all across a forty-acre piece of uncultivated land, moving away from the alfalfa field on one side and many of them eventually reaching an uninfested field on the opposite side of the "forty." Others fall into the irrigating ditches and are swept onward, and at times into a field, where they may secure lodgment on leaves or the stems of the plants. Once they obtain solid footing on they go until they reach a field where food plants are present or until night drives them to shelter. The weevils are quite susceptible to warmth. Even the passing of the sun behind a cloud will drive them to shelter. They go into hibernation early in the fall, rarely coming out and feeding until

spring has opened up. Almost any place, from a haystack to dead leaves along an irrigation ditch, will attract them.

Many live over winter in haystacks, either coming directly on foot from the surrounding infested area or being carried on hayracks during August. Others find their way to the edges of the field and crawl beneath dead leaves or grass along fence rows and ditch-banks. Still others, especially in old alfalfa fields, crawl down between the bases of the stems of the larger plants and remain well protected.

In June I have seen large numbers of the larvæ on hay racks after unloading at the stacks or barns. While the larvæ will never be freely distributed in this manner there are always some that are so nearly full grown that they will pass through the rest of their changes in the protection of the stack or in some sheltered spot near where they have dropped from the wagon.

Coming out of hibernation early in the spring, they feed upon the young leaves to a very slight extent. Eggs are soon laid and where the infestation is at all heavy (that is, where they have been present at least one year) the first crop will be nearly ruined. Cutting this at the usual time shakes the larvæ to the ground and as they are not nearly full grown, they crawl back to the plants, and the result is the second crop has no opportunity to grow, every bud and leaf being cut off until the larvæ are full grown and pass to the ground to pupate.

Injuries

The weevils feed on the stems, rasping off a small amount of tissue, and on the leaves and buds. They never do much harm, but where plentiful the injury can be readily detected. The young larvæ feed in the growing tip, on and between the young opening leaves, buds and even flowers. As they grow older they work their way on the larger and older leaves and often completely defoliate the plant. Where young larvæ are compelled to feed on the older leaves they only skeletonize the foliage. This often gives the plant the appearance of having been frosted, the color, however, being whiter than that following frost injury.

Remedies

No very satisfactory means has yet been devised for handling the insect. It can be checked and its spread somewhat limited by several operations. Different conditions and soils will require different treatment. Poisoning can scarcely be resorted to since it means an entire loss of the crop and would be a costly measure. Burning over the fields in the fall before it is cold enough to drive the weevils to hibernation kills a large number. By scattering straw over fields in the spring

as soon as the larvæ are seen and then burning off the field many eggs and young larvæ will be destroyed and many adults crippled. The alfalfa quickly recovers from the burning and a good crop is assured. Seriously infested fields may be deeply ploughed in late May or early June, in this manner killing practically all the larvæ and eggs and turning under good fertilizing material. While this is one of the surest methods of handling the insect, it will be hard to get the average farmer to consent to such measure, unless it is an old piece of lucerne that will soon have to be broken up. Any means used in the field should not be begun until all the weevils are out from hibernation.

Clean cultivation around the edges of the fields and on the ditch banks, especially burning up all trash after the weevils have gone into hibernation, will aid considerably in controlling them. Unfortunately the weevil is beginning to turn its attention to sweet clover (*Melilotus alba*) and to yellow clover (*Melilotus officinalis*) and red clover (*Trifolium pratense*), the first named plant being very common along roadsides and ditch banks in some localities.

No parasitic insects have been bred from any stage of the species. Horned toads, swifts, and the common garden toad all feed upon the weevil and the latter also eats the larvæ. Chickens will pick up the weevils and if the larvæ are numerous enough will also feed upon them, but do not seem to especially relish the food. A field mouse was found with remains of a weevil and it is probable that some birds will attack them.

Mr. Schwarz: Mr. President, five European species of *Phytonomus* have been imported into this country, three of which, including the alfalfa leaf beetle, are of economic importance. The well-known clover leaf beetle (*Phytonomus punctatus*) was originally introduced into the state of New York. A second species, *Phytonomus nigrirostris,* which for many years was known only in the northeastern states, has suddenly made its appearance in the vicinity of Washington, D. C., and threatens to become as injurious to clover as the original clover leaf beetle. Its natural history is now being worked out by Prof. F. M. Webster.

Insects belonging to the circum-polar fauna or insects that have been imported from Europe into our northeastern states never spread southward, and such invasions as those of *P. punctatus* and *P. nigrirostris* indicate that these particular species were imported from Europe into regions lying south of the transition fauna.

I predict that the alfalfa leaf weevil will spread rapidly to the al-

falfa regions of the West and that it is likely to prove enormously destructive to this important crop.

President Forbes: If there is nothing further on this subject, the next on our program will be by Mr. E. P. Taylor.

AN EXPERIMENT IN THE CONTROL OF CURCULIO ON PEACH

By Estes P. Taylor, *Mountain Grove, Mo.*

The greatest insect problem confronting the peach growers of the Ozarks is the prevention of injuries from the curculio (*Conotrachelus nenuphar* Hbst.). From reports this is also the paramount question with peach growers throughout the whole of the Mississippi River Basin, from the northern limits of the peach on into the great peach-growing district of the south. Nor is the middle-west and south alone the territory involved, for many eastern states find losses from this source quite as heavy. Making no exception for brown-rot, peach scab or other fungus disease, it may, in Missouri, excepting perhaps in those sections into which the San José scale has been introduced, be easily accorded first rank among all spraying problems of the peach grower.

This condition makes the problem today one of the greatest economic interest to peach growers and its solution in a practical way for the benefit of those interested in peach culture is one of the most productive fields now open to the economic entomologist.

The possibility of controlling curculio in apple orchards by means of arsenical sprays cannot now be doubted. This was shown to be possible in experiments conducted nearly twenty-five years ago in Illinois by Doctor Forbes, the present chairman of this Association, and at the meeting held at Philadelphia in 1905 further definite experiments were reported, showing remarkably successful results in this direction. Although apple growers have also employed with varying success other methods of control, the practical results to be derived from arsenical sprays has gained much favor among them within the past few years and there can be no question that spraying is the most important single operation which can be employed to reduce its injuries upon apples.

Our peach growers have, upon the other hand, entertained serious doubts as to the possibility of destroying the beetles in the peach orchard by means of arsenicals. Although here and there tried, summer spraying of peach cannot be said to be anything like a common practice. We must grant at the outset that much of the hesi-

tancy of peach growers to use arsenicals upon peach trees has been due to their fear of doing injury to the foliage or fruit, a fear which in the past, with the use of Paris green, has been well grounded. The advent of arsenate of lead as an insecticide, with its increased adhesiveness and greater safety to the tree, makes the practicability of peach-spraying for this pest seem more promising.

An experiment conducted by the writer this season has given additional and convincing evidence that injury from the curculio can be largely prevented upon peach by proper spraying with a dilute solution of arsenate of lead, and this at a cost and with results which makes the treatment a practical operation to every peach grower in the territory where this insect occurs as a pest. Although this report is intended only as a preliminary one upon this subject and is not presented as a final recommendation to growers, it is thought that a brief account of the investigations thus far conducted and of some of the facts gathered would be timely at this meeting. The results thus far may be also of interest since the plan is, in the main, similar to one being carried out by Professor Quaintance of the Bureau of Entomology.

The Spraying

The spraying experiment was conducted upon a block of 1195 six-year-old Elberta trees belonging to the Olden Fruit Company at Olden, Missouri, and forming a portion of one of the most extensive fruit plantings in the Ozarks, comprising in all about 1,800 acres. The spraying was done with a gasoline power outfit. The spray used was Swift's arsenate of lead, costing about 12 cents per pound, and the average amount required for a very thorough application was about two gallons per tree, or only about one cent per tree per application for insecticide and only between two and three cents per tree per spray when cost of application was also included.

Upon all of the principal plats, containing from 32 to 249 trees, 2 pounds of the paste lead were used per 50 gallons, with the addition of 4 pounds of quick lime for the purpose of neutralizing any free arsenic which might happen to be present. To determine the effect of an increased amount of the lead arsenate upon the tree, a number of small plats were given varying amounts of arsenate of lead, both with and without the addition of lime. The season covered by the spraying was one of unusual rainfall. In the month of April 9.06 inches and in the month of May 10.24 inches were the recorded precipitation at the orchard, while the month of June gave 15 days in which rain fell. Not only were these conditions unfavorable for the best results but several damaging late frosts reduced the crop to a very light

yield, a condition naturally expected to favor heavy infestation by the beetles present.

The Results

A record of the windfall peaches was secured by collection of fallen fruit under trees carefully selected at the beginning of the experiment from the central portions of each plat, so as to minimize the complications in the results otherwise likely to follow from the spreading of the beetles from one block to another. From these indicated trees the ripened peaches were picked on July 31st.

At the time of the picking of the fruit 86% of the peaches in the unsprayed block had fallen to the ground, 94% of them being wormy, as determined by cutting open each peach in making the examinations. Of the few remaining peaches left upon the unsprayed trees at picking time every one was found to have been injured by curculio.

In one plat which received three applications of lead arsenate, the first at the time the petals had fallen, the second thirteen days later, when the "shucks" or dried calyces were shed from the peaches, and the third eleven days later, gave 87% of the picked peaches free from curculio injury.

Another plat, which received only two applications of lead arsenate, the latter two as given in the plat just cited,—one when the "shucks" were shed and another eleven days later,—gave 89% of the picked peaches free from curculio injury.

In still another plat, which received three sprayings of arsenate of lead, one when the "shucks" shed from the peaches, another thirteen days later, and a third eleven days after the second, yielded 94% of the peaches free from curculio, and the best results of all.

It will be seen that a most remarkable improvement was secured by the spraying in the prevention of damage by curculio; a much greater difference than I had expected or even hoped for at the beginning of the experiment.

A secondary beneficial effect was secured in the control of brown-rot and peach scab. In the unsprayed block 61.3% of the picked peaches counted showed brown-rot infection and in practically every case the infection surrounded a puncture made by a curculio. In the plats where curculio was controlled most successfully brown-rot caused practically no damage. In one case where the curculio injury was reduced to 13.3% the brown-rot was reduced to 3.8%, and in another plat where curculio was reduced to 11.4% brown-rot was reduced to 2.3%.

It is almost certain that the adult curculios convey the spores of

brown-rot upon their feet or bodies by crawling first over brown-rot "mummies" or infected spots and then to non-infected peaches, where they may establish newly-infected areas by making new punctures or passing over old ones. This relation of the curculio to brown-rot infection, many times noted by entomologists, is worthy of further careful observations.

Arsenate of lead undoubtedly also possesses some fungicidal properties. Upon apples it has shown such action and in this experiment upon peaches a decided decrease in the amount of peach scab was noted in the sprayed portions over those left untreated.

An additional gain in improved color of fruit was also secured, which alone was enough to almost repay the cost of spraying. The peaches from the sprayed blocks where the best results had been secured in controlling curculio were of a beautiful bright red color, some very dark in fact, making them extremely attractive and adding greatly to their market value. That this color was the effect of the lead arsenate was plain, due in part perhaps to greater exposure of the peaches to the sun by a diminution of the foliage on some trees by spray burning, but chiefly due to direct chemical or physiological action of the arsenate of lead upon the tissue of the peach.

In some plats treated the action of the spray was severe enough to cause burning of foliage and fruit and to cause uneasiness as to the outcome. A spray of lime water was given at one time to some plats to arrest this burning action. In some plats, where the very best results were secured in controlling the insect, some peaches showed unmistakable indications of burning upon the foliage, peaches and small twigs, though from recent observations upon these trees this injury does not appear to have been serious enough to the twigs to materially affect the prospect for fruit upon the trees the coming year.

We may sum up the results of this preliminary experiment as showing the complete possibility of the prevention of the majority of curculio injuries by arsenate of lead sprays but leaving some questions of safety to the tree from the spray still unsettled. Some important points bearing upon this were, however, brought out by the experiment, which will be valuable in the investigation continued upon the subject next year. Some of the points thought to be established and worthy of mention are:

1. The increase of lead arsenate in the spray formula increases the danger of injury.

2. The addition of lime to lead arsenate for peach spraying reduces the danger of injury.

3. The use of lead arsenate as dilute as 2 pounds per 50 gallons with

the addition of 4 pounds of lime is not always safe for peach spraying.

4. Early applications of lead arsenate upon peach are less likely to cause injury than those of the same formula applied later.

5. Lead arsenate used upon peach should be practically free from uncombined water soluble arsenic and should contain a maximum amount of arsenious oxide.

Spraying Suggestions

The following is a scheme proposed for peach spraying for the spring of 1909:

First Spray.—Immediately following the time the "husks" have dropped from the small peaches, which will be when Elbertas usually measure from 1/3 to 1/2 inch in diameter. Use one pound of guaranteed arsenate of lead, 2 pounds quick lime to each 50 gallons of water, applying the spray as a rather fine mist spray, using no more material than necessary to thoroughly coat the surface of every peach upon the tree. The pubescence over the peach will hold the spray and upon drying will leave the poison evenly distributed. This spray will be at about the time the first food punctures are being made.

Second Spray.—About ten days or two weeks following the first application repeat the spray, using the same formula applied as a mist and with the same thoroughness as before. This spraying will be done when numerous punctures, both food and egg, are being made.

Third Spray.—About ten days following the second give a third application in the same manner as before. At this time Elbertas will ordinarily measure 1 to 1 1/3 inches in diameter.

These times for application being based upon development of the peach and with no reference to specific calendar dates should be applicable as guides for the proper timing of sprays for peach growers living in any section.

The treatments, it will be seen, are suggested at a time early in the development of the peach, at the time when the first and when the majority of the food punctures are being made. The experiments this year did not indicate that arsenical sprays applied to peaches previous to the dropping of the dried calyces gave results of sufficient value to justify them. On the other hand, the destruction of the hibernating beetles early prevented egg deposition and intercepted the development of the generation emerging later. Of the three sprays recommended, the first and second are the most important. Peach trees appear to be more susceptible to injury when sprayed later than early. The time when the most adult beetles may be destroyed, fortunately for

the fruit grower, coincides with the time when less injury is apt to be done to the trees by the spray.

This scheme of suggested treatment, it will be seen, reduces the amount of arsenate of lead from the formula used in the experiment. It seems probable, at least, that this amount of arsenical will bring about successful results. Orchardists in some sections are using only this amount of poison in their formulas against codling moth.

None but the best grades of lead arsenate should be used and every package purchased should be required to bear a certificate of analysis, showing quality at least up to the standard established by the national insecticide bill favored by this body for enactment before the coming session of Congress.

MR. SLINGERLAND: What is your theory in regard to the way the poison kills? Does it kill the beetles, or don't they like the spray?

MR. TAYLOR: My belief has always been that it kills the beetles, as it is not supposed that arsenate of lead is a very strong repellent.

MR. QUAINTANCE: The Bureau of Entomology has been interested in this subject for several years, and I am glad to hear Mr. Taylor's paper. It confirms results we got three or four years ago, especially as to the high percentage of peaches which may be protected from the curculio attack. As to the use of arsenate of lead on peach trees, especially as to recommending its use to peach growers in the southern states, I should think it would be unwise without explanations. The effects of the lead on peach varies from year to year, and I think I have never seen the same results twice. Some years there is but little if any harm, and the next year the foliage is badly injured and much of the fruit may fall. Tests of home-made arsenate of lead show but very little difference. This question of injury has been under investigation by the Bureaus of Chemistry and Entomology, and it turns out that arsenate of lead, after being applied to the trees, undergoes decomposition, and the presence of lime or its absence, while entering materially into the question, does not prevent burning. I want to urge that the recommendation as to the use of arsenicals on peach in the southern states be done with caution and that the grower know the risk he is taking.

A MEMBER: What time do you spray, Mr. Quaintance?

MR. QUAINTANCE: Just about as Mr. Taylor said, beginning as soon as the petals are down.

MR. TAYLOR: I would like to ask Mr. Quaintance if he has seen severe injury from the best grades of arsenate of lead where only a

pound of lead was used, with two pounds of lime added per 50 gallons?

MR. QUAINTANCE: Yes.

MR. SKINNER: I have been much interested in this paper, and I think Professor Slingerland's question is very important, as to whether the arsenate of lead is repellent, or whether it acts as a stomach poison. If it is a repellent it seems to me that it would be possible to use some other material that would have the same effect without any injury to the foliage. It has seemed to me that one of the great troubles about economic entomology is that too much reliance is placed on arsenicals, —perhaps I should not say "reliance." From the standpoint of economic entomology there are so many other chemicals that can be used. This Association has demonstrated that the men working on these lines are largely investigators, and at least have some time to devote to investigation, and these investigations of problems are the ones that to me, personally, are extremely interesting. It seems to me that that particular point is one of very great interest, whether these insects are deterred from the fact that the material that they eat is a stomach poison or whether it repels them in some other way, and I am quite impressed with this idea of the subject, and I sincerely hope that the men who have the opportunity of studying these matters will take up that point and report on it.

MR. HINDS: I would like to ask in regard to the feeding of the plum curculio after the crop of fruit has been gathered. Is it practical to apply arsenical poisons after the crop has been removed and when the foliage is stronger than earlier in the season?

MR. TAYLOR: Mr. President, I made some jarring records this summer and found that there were very few beetles on the trees at that time. This is not conclusive evidence that some feeding might not take place, although the number of beetles secured was very small.

MR. SCHWARZ: Mr. President, it is possible that there are two species of *Conotrachelus* that attack peaches. Many years ago, while visiting Prof. H. A. Morgan at Baton Rouge, Louisiana, he showed me specimens of *Conotrachelus anaglypticus* which had been bred from peaches. It would be worth while to try to ascertain the breeding habits of *C. anaglypticus*, as it is one of the common weevils in eastern United States. I do not think that Professor Morgan has ever published this interesting observation.

PRESIDENT FORBES: The next paper will be by Mr. Hinds.

CARBON DI-SULFID FUMIGATION FOR GRAIN INFESTING INSECTS

By W. E. Hinds, *Auburn, Ala.*

It is now fifty years since Doyere discovered that the vapor of Carbon di-sulfid was an effective agent in destroying grain-infesting insects. In 1876 two other French investigators, working particularly with the grape Phylloxera and a few other species of insects, announced that "one part of Carbon di-sulfid vapor in ninety parts of air killed all insects in a few seconds, while one part of the gas in 254 parts of air was fatal in 75 minutes."

An examination of the literature of the United States Bureau of Entomology and the state experiment stations discloses no extended experimental work in this country. This strongly suggests that the recommendation which has been most commonly made, i. e., for the use of "one pound of the liquid Carbon di-sulfid for each one thousand cubic feet of fumigated space during a period of twenty-four hours," has been based upon the report of the two Frenchmen, Cornu and Mouillefert, and that their conclusions have been accepted with little question and little subsequent confirmation. The possible injurious effect of the gas upon the germination of seeds seems to have attracted more attention from station workers in the United States than has the question of killing insect stages. The most extended experiments of which we have found record in this country were conducted by Osborn and Mally in Iowa, Webster in Ohio, and Pettit in Michigan. It is quite possible that other reports of importance may be found in papers which we have not yet been able to examine.

In most of the records which we have seen it is stated that the gas was used at a "saturated atmosphere," but no consideration seems to have been given to the effect of temperature upon the actual amount of Carbon di-sulfid contained in a "saturated atmosphere." According to data furnished by the United States Bureau of Chemistry several years ago, the amount of Carbon di-sulfid in a saturated atmosphere varies with the temperature as follows: At 50 degrees F., 53.5 lbs. of CS_2; at 59 degrees, 64.6 lbs.; at 68 degrees, 77.6 lbs.; at 77 degrees, 92.4 lbs., and at 86 degrees, 109.3 lbs. Thus at 86 degrees slightly more than twice as much of the gas is required to saturate the air as is needed at 50 degrees. Obviously the air temperature at the time of treatment makes a most essential difference in the effective strength of the gas and should be taken into account in all careful experimental work, although it seems to have been disregarded heretofore in the treatment of both seeds and insects. At a temperature of 72 de-

grees the dosage usually recommended will produce but about 1.2 per cent of a saturated atmosphere, while at 50 degrees it will produce about 2 per cent of a saturated atmosphere.

Another consideration involved in interpreting the results as given by various writers for the treatment of insects is the possible temporary asphyxiating effect of the gas, which does not produce ultimate death. In all of the records where we have found mention of the time of making examination to determine the effect of the treatment, it seems that the examination has been made immediately at the close of the treatment. In the absence of statements to the contrary, it seems reasonable to assume that this was probably the case in nearly, if not quite all, of the experiments. Our own observations have led us to believe that such immediate examinations are very liable to lead to incorrect conclusions. We have made it a practice to preserve the apparently dead specimens in each lot as well as the living for continued observation following the experiment. The first effect of the gas is to stupify the insects and this occurs some time before actual death takes place. Thus it is quite possible that in a case where all of the insects appear to be dead on an immediate examination, a large percentage of them will recover upon exposure to the air or under the gradual dissipation of the gas. It may require from one to two days for them to resume normal activities. Some of those which thus become active may indeed be so seriously affected that they cannot recover the ability to feed and so ultimately die as a direct result of the treatment. The standard which we have therefore adopted for our own work is to count as "living" only those insects which subsequently resume their normal activities, either in feeding and in reproduction, or in development and transformation. If they do not thus recover it is evident that the treatment is ultimately and practically effective.

It is not our purpose in this paper to review the work of other entomologists with Carbon di-sulfid, or to question specifically the report of any experimental results. Nor shall we attempt to compare the records of our own experiments with those of any other workers. We have called attention to the apparently foreign origin of our most commonly accepted recommendations for its use and to a few of the many chemical, physical and entomological considerations which seem to have an important bearing upon the interpretation of previously accepted results, merely to show that from our point of view the entire subject of the use of Carbon di-sulfid as an entomological fumigant is still an open question, so far as the scientific points involved in its use are concerned, and that this therefore constitutes an important field, deserving the most careful and thorough investigation possible.

The work which we have yet done in this field at Auburn, Alabama, is but a beginning in line with an investigation which promises to require several years for its completion. The general plan and purposes of the investigation have been outlined in a preceding paper. In this work I am being assisted by Mr. W. F. Turner, to whom is due much of the credit for the execution of the work. Thus far our work has dealt only with corn and cow-peas and some of the insects infesting them. We consider the results as only tentative, but still as of sufficient suggestiveness to be worthy of your consideration. The principal points investigated thus far are the effects of the gas upon the germination of treated corn and upon the life of adults and immature stages of *Calandra oryza*, *Silvanus surinamensis* and *Bruchus chinensis*.

The investigations of Hicks and Dabney, as reported in Circular 11, United States Department of Agriculture, Division of Botany, indicated that field corn is one of the seeds most susceptible to injury by gas treatment. In their experiments the germination of corn treated for forty-eight hours with a saturated atmosphere of gas was reduced forty per cent, or from 94 per cent in the check to 54 per cent in the treated lot. A twenty-four hour treatment, however, resulted in no injury.

In our tests of the effect of the gas upon the germination of seed corn we have used two varieties. Number one is known as "Henry Grady" and is a white, dent corn, which is much subject to weevil attack. Number two is known as "Station Yellow" and is a yellow flint corn, which has been selected for several years to secure greater resistance to weevil attack. Each of the twenty-five lots tested included one hundred seeds and the seeds were taken from several ears so as to make the lots as nearly uniform as possible. One lot in every five was used as a check. The weight of each lot was determined before treatment and immediately after being removed from the gas. The strength of gas used was a "saturated atmosphere" at the room temperature, which was about 68 degrees. The temperature is continuously recorded by a thermograph. The actual strength of gas used was about seventy-five pounds of CS_2 per 1,000 cubic feet.

In two lots the seeds were soaked in water for one hour before being placed in the gas. In this time the seeds gained 11.2 per cent on their original weight. It is sufficient to say that all seeds were killed in these two lots in treatments of forty and seventy-two hours. Other tests have shown that corn will absorb in a two minutes submersion in water as much moisture as it will subsequently lose in two days in

air under an atmospheric humidity of about 65 to 70 per cent of saturation.

In a comparison of lots of seed treated alike before and during the gas exposure, but in which one series was placed in water for soaking preparatory to germination immediately after being removed from the gas and weighed, while a parallel series was allowed to air for twenty-four hours before they were germinated, there appeared to be a greater injury among the seeds which were not allowed to evaporate their absorbed gas before being soaked in water. In the check lots the average percentage of germination was 91; in the treated seed which was aired it was 73, while in that not allowed to air it was but 65 per cent. In both series the seed treated from four to six days germinated practically as well as did that treated from one to three days. The increased length of treatment did not result in a proportionate injury to the germinative power of the seeds. In no case was the injury as great as that reported by Hicks and Dabney for a forty-eight hour treatment. It is evident that the proportion of water in the seed at the time of treatment has much to do with the possibility of gas injury. We have not concluded our investigations along this line.

The second part of our work is concerned with the effects of the gas upon insects either as adults outside of the seed or as immature stages within the seeds. In this work a saturated atmosphere was used in bell-jars, as with the germination experiments. The minimum time for each series of experiments was taken as the time at which all individuals in a lot appeared to have succumbed to the effects of the gas and remained quiet. From this time on each lot was given an added exposure of five minutes. After the treatment the insects were left undisturbed to air for about eighteen hours and were then carefully examined. All specimens, whether apparently dead or evidently alive, were preserved for further continued observation and in numerous cases it was thus found that insects recovered activity after from one to two days, during which they had showed no sign of life.

In the experiments with adults of *Bruchus chinensis* more than fifty per cent was killed in twenty minutes in the gas and about ninety per cent in thirty-two minutes. Among over two hundred adults treated for forty-five minutes only two ever moved after being removed from the gas, and these did not recover sufficiently to feed. With the immature stages, under similar conditions of treatment, practically all stages were killed in a thirty-minute treatment. The effects upon the eggs of this species and upon the germination of cow-peas have not yet been determined. This species is much more easily killed than either of the other two which have been studied particularly.

In similar tests with *Calandra oryza* about seventy per cent of the adults were killed in from thirty to forty minutes, and about eighty-five per cent in from forty to fifty minutes. Among 209 adults exposed for sixty minutes but five showed subsequent signs of life, and one of these survived for three days but did not feed. This individual showed no sign of life until after having been out of the gas for about thirty-six hours. With this species also all treatments of more than one hour's duration resulted in complete destruction of the adults, and also of all immature stages, while nearly all of the latter were killed in the fifty-minute treatments.

By far the most resistant species thus far tested is *Silvanus surinamensis*, which is associated with Calandra and with *Cathartus gemellatus* in nearly all of the corn ears examined to date. While some of these adults were killed in treatments of thirty minutes, or even less, an average of but sixteen per cent was killed among over 200 specimens exposed for intervals of between thirty and sixty minutes. Among 140 adults exposed for periods ranging between 70 and 100 minutes the death rate was but 55 per cent, but among 200 adults exposed for 110 and 120 minutes all were killed.

The strength of gas actually effective in these experiments was between 70 and 80 times that evolved in a treatment using but one pound of the liquid to 1,000 cubic feet of space. As adults in these three species remained active in this strong gas for from 17 to 30, or even more, minutes, we may be excused for doubting the reliability of the statement of the French investigators to the effect that "in an atmosphere composed of one part of CS_2 vapor to 90 parts of air all insects perished in a few seconds." That strength of gas is not likely to be over one-sixtieth of the strength used in our tests in which the three species mentioned were active for more than twenty minutes on the average.

In an actual test of the application of the di-sulfid at the rate of two pounds per 1,000 cubic feet at a temperature of 55 to 60 degrees, for a period of twenty-four hours, the adults of both Calandra and Cathartus appeared to have been hardly disturbed. There was no indication of any mortality having resulted and when removed from the fumigation chamber at the end of the treatment the adults appeared to be moving and feeding normally.

Mr. Hinds: I trust that we may have time for some little discussion along this line, as we shall certainly appreciate the suggestions that will be brought out thereby. I had intended to give a few of the

results which we have already attained in our work, but, owing to the lack of time, will present the paper for publication in the proceedings.

Mr. Sanderson: Mr. President, I certainly am glad to learn of this investigation, because I have been interested in this matter for a long while. We need information on the diffusability of these gases. I did a little work on that some years ago, and I found that my friends who were working in physical science had very little information on that subject which was adaptable to our work, and I imagine there is very little work in pure physics along this line.

I am also interested in Doctor Hinds' presenting this outline to the Association. It has been a feeling of mine for a good while that we could save each other an enormous amount of work if we knew what each was doing. I have had occasion many times to benefit immensely by the plans submitted by other men. It seems to me that these meetings would be much more profitable if we could have more plans offered and short opportunities for discussing them. If time did not permit of that, if each of us would give a brief outline of the projects under way for the next year and the scope of the projects, it would be of immense value in getting together those workers interested along the same lines, so that by correspondence we could get our work in such shape that it could be compared in different parts of the country.

Mr. H. T. Fernald: Doctor Hinds' outline is very interesting to me because for the past four years in my laboratory various students have worked along similar lines, and the paper which I have withdrawn from the program today was practically a summary of that work as bearing on the treatment of certain greenhouse crops,—tomatoes and cucumbers. We have found that humidity is a very important factor, and, strange to say, so far as we have gone, we have found that with tomatoes a rather high humidity was favorable to successful results, while rather low humidity in the other case was preferable.

We have found that the most advantageous treatment with hydrocyanic gas is influenced by the amount of light, even at night. Of course, day-time experiments were unsuccessful. We also found that moonlight night experiments were, in some cases, very dangerous, and that the darkest nights gave the safest results. These results were totally unexpected, but the experiments were carried far enough to show that light entered into the subject.

From the results of these four years' work I have gradually come to the conclusion that there is no factor whatever that can enter into a series of experiments which is too small to be ignored, and I would urge Doctor Hinds and any one who is going into these experiments to

be as certain as possible that no possible factor has been overlooked. Some small thing may turn out to be most important in the end.

MR. SKINNER: I don't know that this is exactly in the line of discussion of this paper, but it is simply a thought that has interested me in regard to economic work for some time, and men like Doctor Fernald, who have student investigators, have an opportunity to take up these studies. It seems to me that with regard to stored grains we can get rid of a good many insects. I would suggest a very simple method, and that is to replace air in proper receptacles; for instance, with a material like carbonic acid. It seems to me that it would be a most effective method, with almost no expense, and it would obviate the question of poisons as we ordinarily understand them. I have made some investigations of these points in a very limited way, and it seems so practical and so self-evident that I bring it before the Association in the hope that some who have the opportunity will take it up. It is such a simple matter to deprive insects of air, and it is so effective when it is done, in spite of what some people say to the contrary, that I am in hopes that the subject may be investigated.

MR. SLINGERLAND: I was very glad that Doctor Fernald spoke about the effect of moonlight. I came across a case some years ago in the Hudson River valley, where they grow violets very extensively under glass. A violet house was fumigated with the usual dose and one night the plants were severely injured by the gas. The only unusual factor that might have caused the trouble was that it was a bright moonlight night.

MR. GOSSARD: A few years ago, in experimenting with fumigating orange trees in Florida, our chemist made some tests to determine the amount of gas generated by combining the acid and water just before the cyanide was thrown into it, and it gave a considerably larger volume of gas than if the acid and water were put together and had time to cool before they were taken into the field. We could save six or seven cents per tree in case of large trees by observing that point.

MR. J. L. PHILLIPS: The past season in Virginia has been rather dry, and some of the nurserymen have complained of injury from fumigation. In one case I found that the stock had been exposed to freezing weather for about twenty-four hours, and this might have caused the trouble in this case. We have had several other complaints this year, and I would like to know whether this has occurred in other states.

The method of the diffusion of gas has seemed to us to be very important, from the fact that some of the nurserymen pack the stock so closely in the house that it is impossible for the gas to circulate. This

difficulty might be overcome by having a slatted arrangement around the inside of the house for the circulation of the gas.

Mr. Burgess: Mr. President, I want to make a statement in regard to the importance of the diffusion and the penetration of gases, especially concerning hydrocyanic acid gas. This summer I had occasion to fumigate a large warehouse in which was stored large quantities of shelled peanuts in sacks, which were badly infested with Indian-meal Moth (*Plodia interpunctella*), and the treatment was not altogether satisfactory. A large number of worms on the outside of the sacks were killed, but there were a good many live ones on the inside, where the gas did not penetrate. A double charge of cyanide was used and the room was kept closed for about eighteen hours, but still the fumigation was not entirely satisfactory. I think we need to know a good deal more about the penetration and the diffusion of these gases before we can attempt to use them successfully in a great many cases.

A Member: Respecting Mr. Phillips' statement and some others about the diffusion of gases, we have been able to get very successful results by putting electric fans in our fumigating houses. By placing the fans in such a position in the house that they stir up the air the gas is sent through the house.

Mr. W. D. Hunter: I should like to say that it seems to me that Doctor Hinds could add very well to the outline he has projected some investigation of other fumigants. Of course, he has hit upon the two, hydrocyanic gas and carbon bisulfide, because they are in common use. They are used by everyone everywhere, but, although he has plenty to do in the investigation of those two gases, it seems to me he might take up other gases. The point I am about to make is suggested by what Mr. Burgess mentioned with reference to the penetrating power of gases. Take the derivative of sulfur, known as Clayton gas, sulfur dioxide, which has, I think, the most remarkable penetrating power of any gas ever used. Investigators have succeeded in killing the germs of typhoid fever in a steel cage, placed in a compressed cotton bale, with a density of fifty-six pounds to the cubic foot. The compressed bale is as hard as wood, and these germs placed in the steel cage have been killed by the gas. I understand now that a very cheap and simple method of generating this gas has been perfected by one manufacturing company. They have a little affair that you can push around that doesn't cost much, and it simplifies the whole matter greatly.

President Forbes: I think Doctor Hinds' expectations must have been very nicely fulfilled by this very interesting and valuable discussion, which has run, perhaps, as far as we can allow it. The last paper on this group of subjects is by Mr. Symons.

SUMMARY OF FUMIGATION AND DIPPING EXPERIMENTS

By Thomas B. Symons, *College Park, Md.*

The desire to verify the results of the rather limited amount of work conducted by other investigators on the effect of various strengths of hydrocyanic acid gas with different exposures upon tender peach buds and at the same time to demonstrate to the nurserymen of the state the great importance of fumigating all propagating stock to prevent the introduction and dissemination of the San José scale prompted us to conduct a series of experiments with this gas during the past three years. The experiments in fumigating buds were conducted at two nurseries in the state under as normal conditions as possible. In addition a series of tests with salable nursery stock badly infested with San José scale was conducted to observe the effect of the gas upon the scale and trees. The trees were fumigated at the nursery and planted out on the Experiment Station Farm. I cheerfully acknowledge the assistance of Messrs. A. B. Gahan, Geo. P. Weldon and L. M. Peairs in conducting these experiments.

1. On September 7, 1906, 505 peach buds were fumigated with 0.40 and 0.50 grams cyanide per cubic foot and exposed to the gas for 30 minutes and 805 peach buds were fumigated with the same strengths of gas and exposed to the gas for one hour. There was a check of 750 buds. The buds were cut from the Early Crawford, Late Crawford, Reeves Favorite, Elberta and Beers Smock varieties of trees in the nursery. The check buds were taken from the same varieties of trees.

An examination of the buds in the experiment October 3, 1906, more than a month after fumigation, showed an average of 98.5 per cent of the buds to be alive, while an examination and count of the buds August 30, 1907, showed 62.6 per cent of those exposed to the gas one half hour and 53.2 per cent of those exposed one hour to be alive. Only 20.9 per cent of the buds in the check were alive at the final examination. The normal per cent to grow in this state is from 60 to 65 per cent.

2. A second experiment conducted at another nursery September 1, 1906, consisted of 2,647 peach buds, Elberta and Champion varieties about equally divided into different tests. They were fumigated with 0.15, 0.18, 0.20 and 0.25 grams of cyanide per cubic foot, with 30 and 60-minute exposures.

An examination of these buds October 9, 1906, showed only 41.2 per cent as an average of buds alive fumigated with the various strengths gas and exposed for 30 minutes, while 49.1 per cent was the average of

those alive that were exposed to the gas 60 minutes. This very poor stand, due to excessive wet weather in the experiment as well as throughout the field, caused the abandonment of further observations. It may be said that it so happened that in each test the 60-minute exposure gave a larger per cent of live buds than the 30-minute exposure at this examination.

3. On September 7, 1906, 270 peach buds cut from orchard trees were fumigated with 0.285, 0.35 and 0.40 grams of cyanide per cubic foot, with an exposure of 30 minutes. An equal number of Elberta and Heaths Freestone varieties were employed in each test and all buds were known to be infested with San José scale.

An examination of the buds on October 13, 1906, showed 100 per cent of the buds in all tests to be alive, while at the final examination, August 30, 1907, an average of 34.2 per cent of the buds were alive. At this examination no live scale could be found on any of the buds, showing that all the strengths killed the scale.

4. On August 27, 1907, 624 peach buds, Late Crawford variety, were fumigated with 0.18, 0.20 and 0.30 grams of cyanide per cubic foot, exposed 45 minutes. All buds in the test were known to be infested with the San José scale. At the final examination, September 10, 1908, an average of 52.7 per cent of the buds in the test and 52.2 per cent of those in the check, which were not fumigated, were alive. No live scale could be found on any of the buds fumigated.

5. On December 4, 1906, 500 nursery trees were fumigated in ten different lots of 20 peach and 30 apple with 0.15, 0.20, 0.30, 0.40 and 0.50 grams cyanide per cubic foot, for 30 and 60 minutes respectively. All trees were badly infested with the San José scale.

At the final examination of the trees, September, 1907, all were living and vigorous. Living scale was found on some of the trees in each test below those fumigated with 0.30 grams per cubic foot, with an exposure of 60 minutes.

A second experiment, consisting of 8 tests with 10 apple trees in each, badly infested with scale, fumigated with 0.15, 0.20, 0.28 and 0.50 grams cyanide per cubic foot and exposed 30 and 60 minutes respectively, was conducted November 2, 1906. This lot of trees were delayed *en route* to College Park and accordingly were not in good condition for planting upon arrival. For this reason no accurate conclusions can be drawn, but at the final examination an average of six trees in each test were living and no more trees were dead in the test with the highest strength of gas and the 60-minute exposure than in the test of the weakest gas, with shortest duration of exposure. Further

living scale was found on some of the trees in each test below 0.20 grams per cubic foot with the 60-minute exposure.

Conclusions

The experiments in fumigating buds demonstrate that a much higher strength of gas and longer exposure than is ordinarily recommended, viz., 0.16 to 0.20 grams per cubic foot, can be employed without endangering the vitality of the buds, and that the exposure to the gas, even at the normal recommended strength, should be at least 45 minutes. In fumigating nursery trees at the normal recommended strength, viz., 1 ounce of cyanide to 100 cubic feet, the duration of exposure should be one hour, and if less time is desired the strength of the gas may be increased with perfect safety to the trees, in order to insure as far as possible the killing of any scale that may be present.

Dipping Experiments

Numerous inquiries as to the effectiveness and practicability of dipping nursery trees in lime-sulfur or other spray mixtures as a preventive against the dissemination of San José scale, either for the purpose of substituting such treatment for fumigation with hydrocyanic acid gas at the nursery or giving such additional treatment by the orchardists before planting as a further means of killing any scale that may have escaped previous treatment, led us to conduct a series of experiments in dipping during the last three years. The tests were not as extended as was desired on account of various circumstances, but the results will add to the rather limited amount of work published on the subject.

1. During March, 1906, 240 dormant nursery trees were dipped instantaneously in the lime-sulfur and salt wash, which was boiled for one hour with steam.

a. 40 apple and 20 peach were dipped, roots and stems in the mixture at a temperature of about 170 degrees Fahrenheit, and a like number were dipped, stems only, in the same mixture.

At the final examination, September, 1906, all trees in the first lot were dead. Only two had started to grow, and all the trees in the second showed that their stems had been scalded. 23 apple and 16 peach in this test had started at or near the top of the ground and were growing.

b. 40 apple and 20 peach were dipped, roots and stems, in the mixture, at a temperature of 120 degrees Fahrenheit, and a like number were dipped, stems only, in the mixture at the same temperature.

Of the first lot, only 10 apple and 3 peach were alive, and of the second, 30 apple and 19 peach were alive and doing well.

2. 69 apple and peach trees were dipped instantaneously, tops only, in the lime-sulfur wash, at a temperature of 122 degrees Fahrenheit, April 27, 1907. In addition about 100 well-grown plants of California privet were dipped in the same solution. Both the trees and privet were infested with the San José scale.

Examination November 29, 1907, showed no injury apparent and no scale could be found on any of the plants.

3. On November 29, 1907, about 200 peach and apple trees, 100 of which were infested with San José scale, were dipped in five different solutions, viz., home-made lime-sulfur at 100 degrees Fahrenheit, Scalecide, Target brand emulsion, Soluble Oil and Kiloscale, the oils being diluted 1 to 15. Part of the trees were dipped roots and stems, and stems alone, in each solution, also scaly trees were dipped in each wash.

Examination of the trees during the past summer and finally October 16, 1908, showed no trees to have been injured in any way by any of the solutions and further no scale could be found on any of the trees.

4. The above experiment was duplicated as far as possible this past spring, the trees being dipped in the same solutions, except that San-U-Zay was substituted for Kiloscale, April 14 and 16, 1908.

Examination of these trees during the past summer and finally October 15, 1908, showed more or less injury by the various oil solutions, but this is no doubt due to the fact that all the trees used in the experiment were just beginning to leaf at the time of dipping. All the trees dipped in the lime-sulfur wash lived and seemed not to be hurt by the solution, while all the trees in two tests dipped in San-U-Zay died. All the trees in the check lived and were thrifty. Further, no scale could be found on any of the trees that were infested before dipping at the final examination.

Conclusions

The experiments of 1906 showed that dipping dormant nursery trees, either roots and stems, or stems alone, in the lime-sulfur wash, at a temperature from 122 degrees to 172 degrees Fahrenheit, may be expected to be attended by severe injury to the trees.

In the 1907 and 1908 experiments no difference could be detected from the appearance of the trees dipped, roots and stems, or stems only, in the lime-sulfur, at a temperature of 100 degrees Fahrenheit and in the various oil mixtures at the strength of 1 to 15. However,

we believe that the dipping of the roots of trees in any of the mixtures at any time to be a rather questionable procedure. They also show that only strictly dormant nursery stock should be dipped in any of the solutions used.

While no scale developed on any of the infested trees after the treatment in either experiment, in view of the published results of other experimenters and the limited number of infested trees included in these tests, we consider that these results may be inconclusive.

Finally these varying results go to show that further experimentation is necessary in order to establish what may be expected from such treatment, even if its adoption for general use should become desirable.

PRESIDENT FORBES: Any discussion on this paper?

A MEMBER: I would like to ask whether you would recommend dipping to the grower who wants to take every precaution to have his trees free from scale? I had that question from a correspondent the other day and would like information concerning it. We get scale right along on our trees when the certificate says they have been fumigated. With the average man fumigation is a little difficult. Is fumigation safe enough and satisfactory enough to warrant our advising growers to dip the nursery stock, omitting dipping the roots?

MR. PARROTT: We have made some experiments in dipping trees. If the farmer desires to dip, I would suggest that he use one of the miscible oils. I do not believe that the lime-sulfur wash has the penetrating qualities of the miscible oils, for in our comparative tests of these sprays we have had much better results with the latter. Moreover, I do not believe that the average farmer will fumigate, and if he desires to treat his trees before planting, I would suggest a miscible oil, but I think it would be better for him to plant his trees first and then to spray them with either the lime-sulfur wash or a miscible oil.

MR. SKINNER: Mr. President, I don't know that it has ever been tried in dipping, but I would like to have some one try solutions of potassium cyanide of varying strength. It ought to be very effective and very cleanly and inexpensive.

MR. J. B. SMITH: I would like to answer Doctor Skinner that it is extremely effective. It kills every plant dipped in it.

MR. SKINNER: I would like to ask Doctor Smith the strength?

MR. J. B. SMITH: I run it down to where it wouldn't hurt insects and it still killed every plant I tried it on.

MR. PARROTT: Since this question has come up, I would like to ask if any of the members have tried any of the concentrated tobacco pre-

parations for the woolly aphis. I have always thought there might be some field of usefulness for these preparations, as dips for this pest.

A MEMBER: Mr. President, last year part of our trees were dipped in a tobacco preparation for the woolly aphis and for the green aphis on the tops. We expect to dip about 20,000 this year. I hope that Mr. Parrott will try it. We are not certain how effective it is.

MR. HITCHINGS: Last week a gentleman came to me and asked if he would be allowed to bring scions from an infested district to Maine, as he wished to use them to graft his trees. He wanted to secure several thousand. Would it be safe to have these scions dipped or should they be fumigated?

A MEMBER: Fumigated every time, I should say.

[The remainder of the Proceedings will appear in the next issue.—ED.]

THE LIFE HISTORY OF THE ARGENTINE ANT

Iridomyrmex humilis Mayr

By WILMON NEWELL

A general account of this species and its habits appeared in the JOURNAL OF ECONOMIC ENTOMOLOGY, Vol. I, p. 21 to 34 and accounts of two inquilines occurring in its nests were given in the same volume, p. 262. On p. 289–293, Mr. E. Foster published an interesting account of the introduction of this ant into New Orleans.

The present paper is intended to deal only with the more salient features of this insect's life history which have been brought to light in the course of the author's studies during the past two years.

There are but three adult forms in the case of this ant, the queen, male and worker. Of the immature forms there are three, egg, larva and pupa, of each the queen, male and worker. There is hardly sufficient difference between the virgin queen and the deälated queen after fertilization to justify considering them as distinct forms. A possible fourth stage may be recognized in the "callow," which is the term used by some writers in referring to the worker which has completed its transformation from pupa to adult but which has not attained the normal worker color and activity. A complete colony may therefore consist of queen and workers only, of queens and workers or of queen (or queens), males and workers: with each of these combinations may be associated any one or all of the three immature stages corresponding to each of the three adult forms, or

nine immature stages in all. Plate 5 shows a colony consisting of one queen, about 100 workers and about 20 eggs, with no larvæ. pupæ or males present.

In size the colonies may vary from a dozen to many thousands of individuals and the number of queens present in a colony may vary from one to many hundreds. Though the Argentine ant is particularly aggressive and a hard fighter when coming in contact with most other species of ants, there is no apparent antagonism between separate colonies of its own kind. In fact, in heavily infested areas the workers and queens are so intermingled that the individuality of colonies is entirely lost sight of and all colonies appear to become part and parcel of one enormous "community." In this respect the species may be said to have a more perfect social organization than even the honeybees, colonies of which are very distinct and the individuals of which repel with alacrity any visitor from another colony.

Methods of Study

When the study of this ant was undertaken two requisites presented themselves, a form of artificial formicary in which continuous observations could be made and individuals kept track of from the time of egg deposition until the adult stage was reached, and some method by which all individuals of a colony could be confined to their own formicary.

Artificial formicaries, or cages, of various types were made and tried. Among them were cages consisting of two glass cylinders placed one within the other, the intervening space filled with soil, the Janet cage, molded of plaster of Paris and having several compartments, and wooden and glass cages constructed in the form of cubes, from which the ants could not escape. None of these met the requirements. In the cylindrical cages crumbling earth often destroyed the galleries and it was impossible to so regulate the space between cylinders that the ants could not construct invisible galleries into which eggs and larvæ were carried.

The Janet cages proved successful only in the case of very large colonies, but in these the multiplicity of individuals made accurate observations impossible. It may be remarked that this type of cage is excellent for studying the community life as a whole and for making experiments with poisons or with parasitic fungi or bacteria.

Cages totally enclosed were not successful for the reason that the ants, when deprived of the privilege of leaving their nest, failed to act in a normal manner.

The cage finally adopted was, with modifications, the one described

by Sir John Lubbock on pages 2 and 3 of his classic work.[1] This consists essentially of two glass plates, containing between them a layer of pulverized earth in which the ants may burrow at their pleasure. Considerable difficulty was experienced in getting the glass plates the proper distance apart: if too for apart the ants could make burrows which were not open to observation and if too close together insufficient room was afforded the queen in which to stand and walk upright. As the queen is about twice as tall as the worker it seemed for a time that a suitable cage could not be constructed.

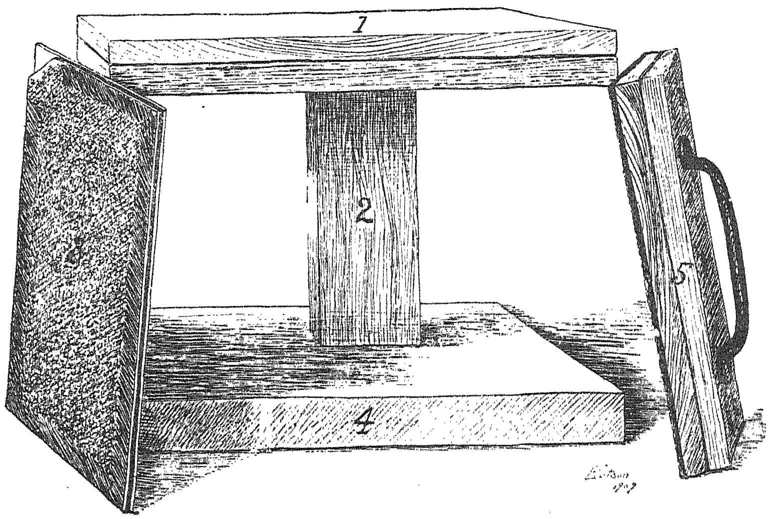

Fig. 1.—Artificial formicary or cage used in studying the Argentine ant: 1, supporting platform; 2, standard; 3, cage proper, made of glass and leather, containing earth; 4, base; 5, cover.

After repeated trials, however, it was found that if the space between the glass plates were made exactly 1.75 mm. the queen would have sufficient room and the workers could not construct invisible galleries.

This type of cage and its supporting stand are well illustrated by Figures 1 and 2. Figure 1 shows the several parts of the cage; "3" is the cage proper, consisting of two plates of glass held uniformly 1.75 mm. apart by strips of leather at all four edges, a door or opening being left at one corner (See Figure 3). Old negatives, the films removed with caustic soda, have been found the most desirable for making these cages, both because such glass is remarkably clear and free from imperfections and because it is of uniform thickness. The

[1]Avebury.—"Ants, Bees and Wasps," 1881.

size of the cage may vary from 3¼ x 4¼ up to 8 x 10 inches or even larger. Leather was found more satisfactory for making the edges of the cage than either glass or wood. The strip of leather betweeen the glass margins is about ½-inch in width. It is extremely difficult to find a strip of glass uniformly 1.75 mm. thick and it is also difficult to firmly attach one piece of glass to another. Wooden strips present the disadvantage of quickly decaying and of warping, no matter what glue or cement is used to hold them in position. Since

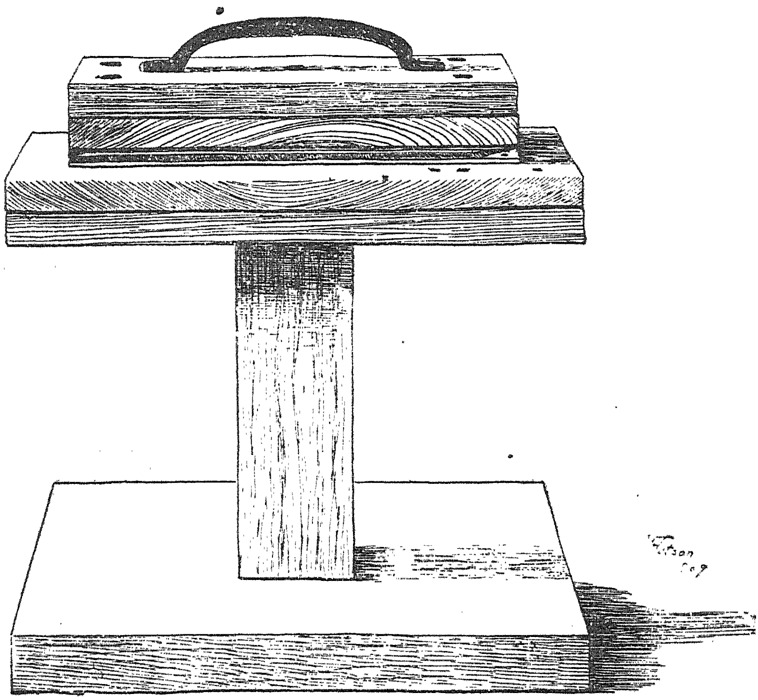

Fig. 2.—Artificial formicary with parts assembled ready for use.

it is sometimes desirable to place moist earth in the cages, or to add moisture from time to time, a waterproof cement is most desirable for attaching the glass plates to the leather strip. For this purpose the cement known as coaguline has been found satisfactory. The space between the glass plates is filled with finely pulverized earth, after completion and drying of the cage, and in this the ants are permitted to burrow and construct galleries as they please.

The cage proper is supported on a platform (1) which in turn rests firmly upon a standard (2) having a base (4). The platform must have its upper surface perfectly level and it must remain so for an

indefinite time, otherwise the ants will take up their abode between the cage and platform rather than in the cage itself. The platform is therefore made of two pieces of even, seasoned cypress 7/8 inches thick, screwed together with numerous screws and with the grain of the two pieces at right angles to each other. On this platform the cage rests without fastenings of any kind. The cover (5) is constructed of two pieces of cypress in the same manner as the platform, but in addition has an iron handle attached to its upper surface and has a piece of felt glued to its under surface so that, when it is placed upon the cage proper, all light is excluded except at the entrance. The cover is of the same outside dimensions as the cage itself. To insure the platform remaining level it is often necessary to make

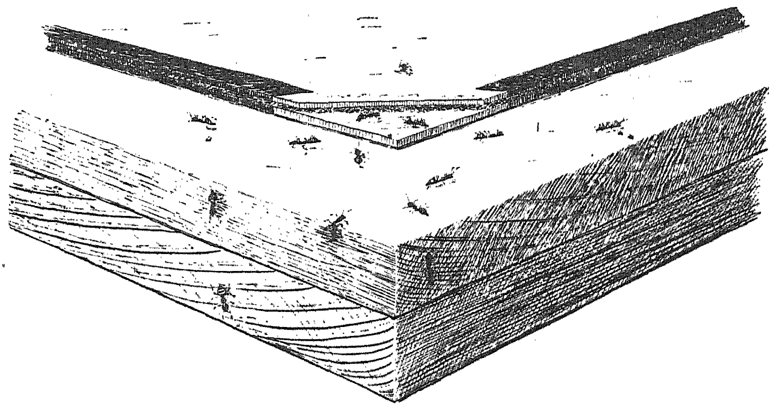

Fig. 3.—Entrance of formicary shown in figures 1 and 2 (figs. 1, 2 and 3 from original drawings by Miss Ethel Hutson).

the base of two pieces in the same manner as the platform, or to nail strips across it at right angles to the grain. Both platform and base are attached to the standard by long screws with heads countersunk. Food is furnished by placing it on a piece of cardboard at any point on the cover or platform. The base stands in running water, as explained below. This type of cage permits the ants to leave their nest within the cage and to forage over the platform, cover and stand in natural fashion, but their escape from the stand is prevented by the very natural barrier of water which they find when they approach the bottom of the standard. It is not possible for them to conceal larvæ or eggs where the observer cannot find them and they cannot bring in larvæ or pupæ from outside sources, to the annoyance and vexation of the student.

While the ants are very fond of sweets we have found that sweets

alone will not suffice for food indefinitely. Animal food is also required and we find that by supplying the colonies with a "balanced ration" of honey and fresh beef or veal, they will work in a perfectly natural manner for many months without other food.

The problem of confining the ants to the cage and its stand was not so easily solved. We first tried Sir John Lubbock's method of placing a moat of glycerine or water about the stand, but both liquids dried too quickly and were effective for only a few hours. Recourse was had to the proverbial chalk line without success. Bands or ditches of kerosene, crude oil, tar, oils of sassafras and citronella, tree tanglefoot, zenoleum, naphthaline, coal tar disinfectants, whale-oil soap, sharp-edged tin and fur were all failures. Certain powerful odors, such as those of zenoleum, sassafras and citronella, act as repellents temporarily, but after a few hours of evaporation are no longer effective. Ordinarily these ants will not cross bands of cotton tape which have been impregnated with a saturated solution of corrosive sublimate and dried, but when attempting to leave an area to which they have been confined by this means they are much more persistent in crossing it.

Water with a film of whale-oil soap on it acted as a repellent for a few hours only, while a film of kerosene upon water merely afforded a convenient floor upon which the ants could travel. The difficulty in confining the workers with any liquid or mucilaginous substance lies in the fact that they are exceedingly light[2] and sticky substances shortly harden on the surface so that the workers are supported. The surface film of clear water is in fact almost strong enough to support a worker not loaded. It is not unusual to see an ant alternately walking and swimming in crossing a narrow ditch of water which has been standing for a few hours. Minute dust particles collecting upon standing water shortly form a film upon which the workers pass with ease. Perfectly fresh water therefore served to confine the colonies to their cages and at first our observations were made upon colonies in cages which were standing in dishes of water. This, however, necessitated frequent changing of the water, and observations were often brought to an abrupt finish by other duties preventing the change of water in the vessels at the right time.

Our next step was to construct a small building, 10 x 30 feet, equipped with benches having upon them galvanized iron trays 2½ x 12 feet, 4 inches deep. In these trays the cages are placed and by suitable connections running water 2 inches deep is kept

[2]The average weight of one worker is 0.0002077 grams.

passing through the trays day and night. As the ants will not voluntarily enter running water this method has worked admirably. The building in which this work is carried on is shown in Plate 6. The iron trays and ant cages are shown upon the right, with work tables, chemicals, etc., on the left. The building is equipped with electric lights and extension lights for night examination, in addition to gas, and a combined hygrograph and thermograph records the temperature and humidity of the room at all times. For convenience we have called this special building a "formicarium"—which the office boy invariably confuses with "auditorium" and "natatorium." Plenty of windows insure full ventilation at all seasons; and to avoid abnormally high temperatures in summer a second or accessory roof, 2 feet above the main roof, breaks the rays of the sun and shades the building proper. The building has also proven a convenient insectary for the breeding of other insects. The Argentine ant possesses a marked proclivity for attacking all insects which one has *under observation*, and all breeding experiments in cages, no matter what the insect, must be protected from the ants. The trays of running water therefore serve to keep the ants away from general cage experiments, as well as to confine the ants to the cages in which they themselves are being studied.

It may be mentioned that Prof. C. W. Woodworth of California visited this "formicarium" in the summer of 1908 and so pleased was he with the cages and the plumbing arrangements of the formicarium that he returned to California and prepared a similar outfit for the study of the Argentine ant there.

Establishing Colonies for Study

To establish a colony in one of the artificial formicaries or cages is comparatively easy. It is only necessary to secure a fertile queen from some thriving outdoor colony and place her on the stand, first placed in water, together with any desired number of workers which have been captured by attracting them to a sweetened sponge or piece of fresh meat. Any lot of workers will accept any queen and *vice versa*. When queen and workers are thus placed upon the cage and its stand, they usually, after a few hours, take up their abode in the nest proper. At first we experienced some difficulty in preventing them from collecting beneath the stand, but it was presently found that if a little dirt be removed from another colony and placed in the entrance of the new formicary the ants would enter at once and adopt it as a suitable home. After the establishment of such colonies the queen usually commences egg deposition in from 6 to 48 hours.

By establishing colonies in this manner, without immature stages present, it is easy to observe the daily rate of egg deposition, the incubation period of the eggs, and the duration of the larval and pupal stages. In some of the records given below single individuals have been kept under observation from deposition of the egg, through larval and pupal stages, to the adult. In other cases the time from deposition of the first egg until hatching of the first larva was assumed to be the period of incubation, date of hatching of first larva to formation of first pupa the duration of larval period, etc.

The Queen

The deälated queen is well illustrated at c, figure 4.[3] The deälated queen measures from 4.5 to 5 mm. in length and queens measuring 6 mm. in length are not uncommon. It should be remarked here that during egg laying periods the abdomen is much larger and longer than shown in the drawing. Normally the abdomen extends well beyond the tarsi of the hind legs. Unfortunately, a drawing cannot show the delicate silky pubescence of the queen's body and in life she is a far more beautiful creature than one would imagine from the drawing, correct though the latter is in anatomical detail.[4]

The credit for first discovering and recognizing the queens of this species seems to belong to Mr. E. Baker, formerly superintendent of Audubon Park, New Orleans, and Prof. R. E. Blouin, formerly in charge of the Audubon Park Experiment Station. Queens found by them in August, 1905, are still in the writer's collection.[5] If Mr. Titus was familiar with the queens he evidently failed to mention it in his interesting account of this species.[6]

The rate at which the queen deposits eggs varies with the prevailing temperature and egg deposition is suspended entirely at low temperatures. In the artificial formicaries, already described, the num-

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[3]The writer is under obligations to Dr. W. M. Wheeler for a critical examination of the drawings shown in figure 4 prior to their engravure.

[4]For a detailed description of the queen, see JOURNAL OF ECONOMIC ENTOMOLOGY, I, p. 29.

[5]Following is the letter from Professor Blouin, announcing the finding of these queens:

Audubon Park, New Orleans, La.,
August 21, 1905.

Mr. Wilmon Newell, Shreveport, La.

DEAR SIR: I enclose you a few specimens of the queen ant of the species recently investigated here by Mr. Titus, named by him the New Orleans ant, or *Iridomyrmex humilis* Mayr. These were collected by Mr. E. Baker, Supt. of Audubon Park, in his nursery right close to us.

(Signed) R. E. BLOUIN.

[6]Bulletin 52, Bur. of Entomology, p. 79.

ber of eggs laid each day varies from one or two to as many as fifty or sixty. Thirty per day is not far from the normal number in warm weather when the food supply is abundant. It appears probable, however, that the queens deposit much more rapidly in large colonies, although, from the nature of the case, this cannot be verified by direct observation. Egg deposition becomes very slow, or ceases entirely, when the daily mean temperature falls below 68° F.

Practically all queens under observation have shown a disposition to suspend egg deposition entirely for longer or shorter periods,

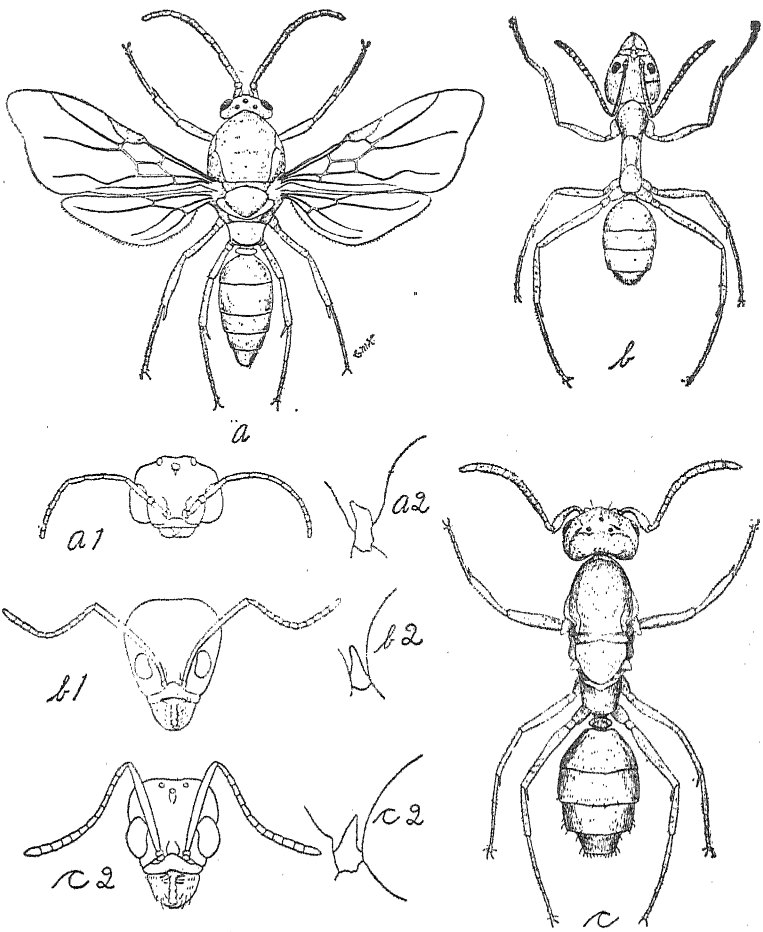


Fig. 4.—The Argentine ant: *a*, adult male; *a1*, head of male; *a2*, petiole of male; *b*, worker; *b1*, head of worker; *b2*, petiole of worker; *c*, fertile queen; *c2*, head and petiole of queen; all greatly enlarged (from original drawings made under the author's direction by Miss C. M. King).

even when such "off" periods cannot be accounted for by low temperatures.

Fertile queens confined in test tubes without accompanying workers will often deposit a few eggs upon the walls of the tubes, but we have been totally unable to get colonies established by confining queens in artificial formicaries without workers accompanying them. This failure has not been due to any need of workers to feed or care for the queen, since she can feed herself from a supply of honey or sugar as readily as can a worker. Ordinarily, she attends to her own toilet and it is doubtful whether she is in reality "attended" by the workers in the sense that queen bees are attended.

Fertile queens do not confine themselves to the formicaries, either natural or artificial. Isolated deälated queens are not infrequently found wandering about buildings by themselves and, while the queens in artificial formicaries ordinarily stay within the nest proper, they have at times been seen outside of it. The finding of deälated queens wandering about, coupled with the fact that workers readily accept a queen from any source, seems to indicate that new colonies may sometimes be established in nature by workers associating with such wandering queens. This probable method of colony formation is quite distinct from the pronounced division, or "divisional migration," which is referred to on a subsequent page.

All immature stages of the queen are as yet unknown. In the two seasons during which colonies have been under almost daily observation, not a single queen has been developed in any of the artificial formicaries, though males have been developed in abundance.

Virgin queens should be easy to discover in areas heavily infested by the species but such is not the case; nor have we been able to detect any of the virgin queens when the males were flying in abundance. Only three virgin queens have thus far come under our observation. These were found on April 21, 1908, by Messrs. Rosenfeld and Barber, two of my assistants, in the course of examining a very large colony which had been driven from a low marshy area by the rising waters of the Mississippi River.

The Worker

The worker measures from 2.25 to 2.75 mm. in length and is well illustrated in figure 4, *b*. As with the queen, the abdomen extends to about the tarsi of the hind legs when the worker is active or engaged in feeding. The abdomen is capable of considerable distension, and when the worker is fully engorged with syrup or other liquid the chitinous plates of the abdomen are forced apart, rendering

the connecting membranes distinctly visible. The writer has often noticed workers returning from their attendance upon plant lice with abdomens so distended that they looked like little drops of silvery liquid. Particularly is this appearance presented when the returning workers are viewed with a strong light beyond them.

As already stated there is but one caste among the workers. In a large colony there seems to be something of a division of labor, certain ones engaging in foraging, others in nursing and still others in excavating or sanitary work. However, any individual worker can assume the duties of any other and does do so when exigencies demand. Worker callows, barely hardened into mature adults, go forth in search of food and the hardened veterans of many months' service seem to make as efficient nurses as even the youngest.

The workers are particularly long-lived. A colony of about seventy workers was made queenless and broodless on July 8, 1908. By October 10th the number of workers had become reduced to about forty and some of the original ones survived until February 25, 1909, a period of 6½ months. But for the fact that many of these workers met death accidentally a longer period of survival would doubtless have been recorded.

The Egg

The egg, which is to produce a worker, is elliptical, about .2 mm. wide by .3 mm. long. It is pearly white, lustrous and without markings (See Plate 7, A). As time for hatching approaches it loses its brilliancy and the surface takes on a duller appearance. This is not sufficiently pronounced and uniform, however, to be taken as a safe guide to immediate hatching. The egg membrane is exceedingly thin, so thin in fact that when the embryo has taken on the larval shape, the membrane not infrequently adapts itself in a way to the general contour of the enclosed embryo, thus making it very difficult to distinguish between eggs and just-hatched larvæ.

Some care of the egg by the workers seems essential to complete embryonic development. Eggs deposited in test tubes by isolated queens have gone through a portion of the embryonic development, but we have not been successful in getting them to hatch. This may be due in part to the ease with which the delicate embryos can be injured in handling and to the fact that when placed on glass condensing moisture may retard or stop development.

Incubation

The eggs, after deposition by the queen, hatch in from 18 to 55 days, according to the prevailing temperature. The longer periods

are doubtless accounted for by embryonic development being entirely suspended during cool weather, and it is not impossible that the viability of eggs may be entirely destroyed by a temperature as low as 25 or 30°, but on this point we are as yet undecided.

The period of incubation has been determined, ordinarily, by placing a queen and workers, but no immature stages, in an artificial formicary and then noting the time from deposition of the first egg to appearance of the first larva. This period was assumed to be the real period required for incubation. In other cases, single groups of eggs have been kept under constant observation throughout the entire period of incubation. The following table shows the variation in development at different seasons, together with the average daily mean temperatures prevailing:

TABLE I

DURATION OF EGG STAGE AT DIFFERENT SEASONS—WORKER

Record No.	From	To	Days.	Average daily mean temperature during period.	Average daily mean humidity.
1........	Oct. 1, 1907	Nov. 15, 1907	45½	*	....
3........	Dec. 22, 1907	Feb. 14, 1908	55	*	....
4........	Mar. 14, 1908	April 9, 1908	27	70.3°F.	70.2%
6........	May 1, 1908	May 23, 1908	23	74	68.9
7........	July 20, 1908	Aug. 10, 1908	22	81	82.9
8........	July 25, 1908	Aug. 12, 1908	19	81	81.5
		Average	32		

The Larva

The larva when first hatched is not distinguishable from the egg without the assistance of a magnifying glass. For a time after hatching the body is severely curved, the cephalic end being almost in touch with the caudal end, but as development progresses the larva assumes more and more of a straight form. The curvature is not entirely lost, however. A recently hatched larva, measured with the compound microscope and eye-piece micrometer, measured .49 mm. long by .32 wide. The fully grown larvæ (workers) average 1.7 mm. long by .66 mm. wide. The largest one under our observation measured 1.87 mm. by .765 mm.

*Cages kept in office; record of exact temperatures not available. The balance of the records were made in the "formicarium" and the recording instruments kept in the same room with the cages, hence the temperature and humidity records are correct for the exact location of the eggs under observation.

The larvæ are fed often by the attending workers upon regurgitated, and presumably predigested, food. There is nothing in the appearance or actions of the workers which do the feeding to indicate that they are different from those which perform other duties, or that they are assigned to the particular and exclusive duty of being nurses. The feeding of the larvæ has several times been observed under a magnifying glass and is as follows: The larva ordinarily lies upon its side or back. The attending worker approaches from any convenient direction, usually from one side or from the direction in which the head of the larva lies and, spreading her mandibles, places them over the mouth-parts of the larva which are slightly extruded. The tongue of the worker is also in contact with the larval mouth. While the worker holds body and mandibles stationary a drop of light-colored, almost transparent fluid appears upon her tongue. This fluid disappears within the mouth of the larva, but it cannot be ascertained to what extent the larval mouth-parts are moved during the operation, owing to their being obscured from view by the mandibles and head of the attending worker. Slight constrictions of the larval abdomen during feeding are sometimes noticeable, at other times not. The time required for feeding a single larva varies from 3 to 30 seconds, depending doubtless on the hunger of the "baby."

The workers proffer food to, or at least inspect, each larva, for the worker doing the feeding will place her mandibles to the mouth of one larva after another, feeding those which seem to require it.

Both larvæ and pupæ are groomed or licked with the tongues of the workers; thus are they ever kept in a state of absolute cleanliness.

The most pronounced increase in size of the larvæ occurs during the first five days after hatching; after that it is relatively slower. As the larva increases in size the contents of the alimentary canal, dark in color, can be seen through the walls of the abdomen.

Just prior to transformation into pupa, the larva takes on a rather characteristic appearance, which if it were more distinct, would justify characterization as the "pre-pupal" stage. In this stage the cephalic and thoracic portions of the larva become markedly smooth and shining, with segmentation indistinct or absent. At the same time the line of demarcation between thorax and abdomen becomes more distinct and the contents of the alimentary canal appear to be shifted nearer to the caudal end than in the larva proper. The mouth-parts, indistinct in the larval stage, now appear more prominent. The difference between larval and pre-pupal stages is by no means pronounced, but with practice one can predict the approaching transformation to pupal stage by it with reasonable accuracy.

The duration of the larval period has been determined by observation in the artificial nests in the same manner as the incubation period, already described.

The following table shows the duration of the larval period at different seasons:

TABLE II

DURATION OF LARVAL STAGE AT DIFFERENT SEASONS—WORKER

Record No.	From	To	Days.	Average daily mean temperature during period.[7]	Average daily mean humidity.
1........	Nov. 16, 1907	Jan. 15, 1908	61	52.2°F.	....
6........	Feb. 5, 1908	April 1, 1908	57	62.2	71.9%
8........	Feb. 5, 1908	April 1, 1908	57	62.2	71.9
10.......	Feb. 15, 1908	Mar. 28, 1908	43	62	72
3........	Feb. 29, 1908	Mar. 26, 1908	27	67	73
9........	April 10, 1908	April 24, 1908	15	76.6	75.3
7........	April 12, 1908	April 25, 1908	14	76.1	75.2
2........	July 19, 1908	Aug. 1, 1908	14	80.5	82
11......	Aug. 13, 1908	Aug. 27, 1908	15	81.7	71.7
4........	Sept. 4, 1908	Sept. 14, 1908	11	81.1	73.6
		Average	31		

The Pupa

The pupa immediately after transformation from the larval stage is pure white, without markings, except that the compound eyes are prominent as jet black spots upon the head. The pupa is slightly larger than the grown larva, the average length being about 2 mm. The head is by far the most prominent portion. A pupa measuring 2.04 mm. in length was found to have a head 1.19 mm. in length (dorso-ventral diameter) while the thorax and abdomen measured .51 and .561 mm. respectively. The pupæ are shown in Plate 7, *b* and *d*.

As time for transformation to adult approaches the pupa changes to a creamy color, then through a light brown to a dark brown, the latter shade being practically identical with the body color of mature workers. The time of these changes varies with the duration of the pupal stage, but the following record of changes in color of a pupa which occupied a full twenty days from larva to adult (callow), is near the average:

[7]We have not attempted to give the accumulated effective temperature necessary for the development of different stages, as we are not satisfied as to the critical point from which it should be computed. It is doubtless higher than 43° F.

1st to 17th day—Pupa pure white, except compound eyes.
18th day—Turned to a light creamy yellow.
19th day—Became a light brown.
20th day—The brown color deepened.
21st day—Reached teneral stage.

In some colonies there is more or less of an indistinct sorting of the immature stages, pupæ being placed in one portion of the nest and larvæ in another. This tendency is not perceptible in many colonies and is usually most noticeable in very large colonies.

The duration of the pupal stage has been determined in the manner already described for the incubation and larval periods. The range of pupal development is shown in the following table:

TABLE III

DURATION OF PUPAL STATE, INDIVIDUAL WORKERS, 1908

Record No.	From	To	Days.	Average daily mean temperature during period.	Average daily mean humidity.
1........	Jan. 21	Feb. 14	25	56.5° F.	68.3%
2........	Mar. 14	Mar. 27	14	67.5	71.8
5........	Mar. 26	Apr. 11	17	73.8	68.9
6........	Mar. 30	Apr. 14	16	73.8	70.2
3........	Apr. 5	Apr. 15	11	76	73.5
10.......	Apr. 5	Apr. 18	14	76.3	74
7........	Apr. 5	Apr. 20	16	76.7	74
8........	Apr. 8	Apr. 23	16	76.6	74.5
9........	Apr. 25	May 13	19	71	63.5
11.......	Apr. 25	May 14	20	71.2	61.4
4........	Aug. 1	Aug. 11	11	82.2	80
12.......	Aug. 6	Aug. 16	11	83	74.8
13.......	Aug. 10	Aug. 20	11	82.8	70.7
14.......	Aug. 28	Sept. 7	11	81.4	71
		Average	15		

The Callow or Teneral Stage

During the last few hours of the pupal stage the legs, mouth-parts and antennæ become more prominent and the pupa is assisted in its transformation by the workers, who attempt to straighten out the legs and antennæ. We are convinced that there is a very thin transparent membrane or skin surrounding the pupa, which is shed at time of transformation but its existence is difficult to establish satisfactorily.

Immediately after transformation the young worker is colorless, almost transparent, but is otherwise identical in appearance with fully matured workers. To this stage, following the custom of some authors, we apply the term "callow." The callow is at first very clumsy and walks with uncertain steps and staggering gait, reminding one much of a worker bee just emerged from the brood comb. During this stage the workers seem still to feel a responsibility for the callow's welfare, for upon the colony being disturbed the callows, like larvæ and pupæ, are unceremoniously grabbed up by the workers and hustled to a place of safety.

The body of the callow deepens in color quite rapidly and in from 48 to 72 hours after transformation from the pupa becomes indistinguishable from other adult workers.

Time Required for Complete Development

By adding together the minimum periods required for the development of eggs, larvæ and pupæ, as given in Tables I, II and III, we find that at least 41 days are required for development from egg to adult and in a similar manner addition of the maximum periods gives 141 days as the maximum time required.

From the tables also it is seen that the average period of incubation for the eggs is 32 days, for development of the larvæ 31 days and for maturing and transformation of pupa to adult 15 days. By adding together these averages we arrive at 78 days as the average period of development. This of course cannot be termed the time required for the development of a generation, since workers do not reproduce and the term "generation" can be used only in referring to the succession of queens.

The Male

The appearance of the adult male is well illustrated in figure 4, *a*. The males average about 2.8 to 3 mm. in length. The most noticeable feature about them is the manner in which the thorax is enormously developed. The abdomen is relatively small and the head short and blunt. The shape of the head alone permits distinction between the male and virgin (winged) queen without the aid of a glass.

The normal time of appearance of the males in the colonies is in spring, but the appearance of a relatively small number in autumn is not uncommon. During mid-winter and mid-summer none are found. The males have been bred in the artificial formicaries in large numbers, hence abundant opportunity has been afforded to study their appearance and habits. The following account of their appearance in

one colony under observation is typical: In Cage 1 the first male pupa made its appearance on April 11, 1908, and by April 15 the male pupæ were numerous. The first of these reached maturity on May 1st. By May 11th the adult males in the colony numbered 11 and on this date some of them essayed a flight. For several days following daily flights were made, most of them terminating ignominiously in the galvanized iron trays of water.

On May 14th the male pupæ in this colony were still appearing abundantly and they continued to appear, at a deceasing rate, until June 27th. By July 8th but one male remained in the colony and this one disappeared by July 22d.

Examinations of the outdoor colonies during May showed males present in practically all of them. Flights out of doors were common during May but we were unable to find any virgin queens among the flying males.

In the autumn males are found in but a small percentage of the outdoor colonies and they rarely appear in the artificial formicaries. In December of 1907 one of my assistants found males exceedingly abundant in a single colony, while in another colony an assistant noticed them constantly present during all of November and December of the same year. In October of 1908 a few males were found in a single outdoor colony. We have found no virgin queens in the autumn.

The eggs which produce males are indistinguishable from those which produce workers and we have found no way to separate the male-producing larvæ from the worker-producing larvæ until just prior to pupation. The male larvæ grow to a somewhat larger size, on the average, than do the worker larvæ and it is thus possible to predict with some degree of certainty which of grown larvæ will transform to males and which to workers. As soon as transformation to pupa takes place there is no further confusion. The male pupa is fully 50% larger than the worker pupa and has, by comparison, an enormous thorax. The male pupæ vary in length from 2.78 to 3.23 mm., with an average length of 3.04 mm.[8] As the average length of the thorax alone is 1.9 mm., it is at once seen what a relatively large part of the body it constitutes. The male pupa is shown in the center of Plate 7.

When first transformed from the larval stage the male pupa is pure white, with exception of the compound eyes, which are faintly tinged with brown. Gradually the color of the compound eyes deepens and

[8]From measurements of 10 specimens by Mr. Arthur H. Rosenfeld.

the ocelli become visible as minute dark spots upon the head. The male pupa, like the worker pupa, passes through gradations of creamy yellow, light brown and dark brown to almost black before transforming to the adult stage. The color reached by the male pupa just prior to transformation is much deeper than that attained by worker pupæ. The males are assisted in their transformation to the adult stage by the workers, and the pupal skin, or at least a portion of it, is worked backwards to the tip of the abdomen and there shed entirely. Within a few hours after transformation the wings of the male become fully expanded. The following table shows the duration of the male pupal stage at different seasons:

TABLE IV

DURATION OF PUPAL STATE, INDIVIDUAL MALES, 1908

Record No.	From	To	Days.	Average daily mean temperature during period.	Average daily mean humidity.
1........	April 11	May 1	19½	73.6°	69.8%
2........	April 14	May 4	20½	73.6	68.6
3........	April 14	May 4	20½	73.6	68.6
4........	April 17	May 10	24	72.3	67.3
7........	April 17	May 10	24	72.3	67.3
8........	April 18	May 11	24	72.2	66.7
9........	April 18	May 13	26	72.8	66.5
5........	April 20	May 13	24	71.8	65.8
6........	Sept. 24	Oct. 21	28	70.5	67.6
		Average	23½		

Formation of New Colonies

Reference has already been made to the possibility of new colonies being formed by workers associating themselves with wandering or migratory (?) fertilized queens. However, the more common method of colony formation is a very different process. In the autumn months there is a marked tendency for colonies to unite and seek dry sheltered situations, such as masses of leaves, straw, etc., in which to pass the winter. Comparatively few colonies attempt to pass the winter in underground nests unless these are situated in protected places, as under buildings, boards, vegetation, etc. The large winter colonies frequently contain hundreds of queens. With the approach of warm weather small colonies, varying in size from one queen and a dozen or two workers to a half dozen queens and several hundred workers, migrate out from the large over-wintering colonies and establish them-

selves in new situations, by preference in soft earth. This spring movement is sufficiently pronounced to be termed a migration, and from its nature it seems best to call it a "divisional migration." In the spring of 1908 it was noticed to occur in the early part of March. The present season this movement began as early as February 13th. This spring division of large colonies into small also explains why large colonies are the rule in autumn and small colonies the rule in spring.

Scientific Notes

A Remedy for House Fleas.—In the latter part of last May (1908) I moved into a new house that had not been previously occupied. No carpet was used and being summer only a few rugs were placed on the floors. A part of the household consisted of a collie dog and three Persian cats. Very soon the fleas appeared, the dog and cat flea, *Ctenocephalus canis*. I did not count them and I can't say whether they numbered a million or only a hundred thousand. On arising in the morning and stepping on the floor one would find from three to a dozen on the ankles. The usual remedies for fleas are either drastic or somewhat unsatisfactory. The drastic one is to send the animals to the institutions, where they are asphyxiated, or take the other advice, "Don't keep animals."

I tried mopping the floors with a rather strong solution of creolin but it did little good. Previous experience with pyrethrum was not very satisfactory. Knowing the volatility of naphthaline in warm weather and the irritating character of its vapor led me to try it. I took one room at a time, scattered on the floor five pounds of flake naphthaline and closed it for twenty-four hours. On entering such a room the naphthaline vapor will instantly bring tears to the eyes and cause coughing and irritation of the air passages. I mention this to show how it acts on the fleas. It proved to be a perfect and effectual remedy and very inexpensive, as the naphthaline could be swept up and transferred to other rooms. So far as I am concerned the flea question is solved and if I have further trouble I know the remedy. I intend to keep the dog and the cats.

HENRY SKINNER, M. D.

Kerosene Emulsion for Terrapin Scale. A number of soft maples, literally loaded with *Eulecanium nigrofasciatum* Perg., were sprayed April 25, 1908, with a lime-sulfur wash, using 20 lbs. of lime and 15 lbs. of sulfur. The spray was applied hot and very thoroughly, about 10 gallons being used for each tree having a trunk diameter of 8 to 10 inches. Similar trees were then sprayed with a stock solution of kerosene emulsion, made seven months before and diluted to make a 20% solution. Many of the twigs with a diameter of over ½ an inch were completely covered with scale. The temperature at the time of application was about 60° F. and the leaves were nearly the size of a fifty cent piece. About 45 minutes after the oil application there was a terrific rain storm, lasting 15 to 20 minutes. The kerosene emulsion killed very few leaves, while the lime-sulfur wash did no injury.

Limbs taken from the sprayed trees and checks showed that the lime-sulfur wash killed no scales, while the kerosene emulsion destroyed practically all.

CHAS. R. NEELLIE, *Cleveland, Ohio.*

Membracid Eggs in an Apple. In November, 1908, from Des Moines, Iowa, I received an apple which had in its skin a number of Membracid egg pouches similar to those made by *Ceresa taurina* Fitch. These pouches were just beneath the skin of the apple and nineteen were counted when the apple was received. Several had already been removed by the sender, Mr. W. H. Kinkennon, who first noticed them. A row of thirteen extended in a nearly straight line from the "equator" of the apple to a point near the calyx, with six more in a line part way around the calyx end. All of the pouches were placed with the long axis parallel to that of the apple. The egg pouch itself was an oblong swelling in the skin of the apple, having a small slit lengthwise at the lower left-hand side (the apple with the stem end upwards). There was no discoloration of the apple skin in the vicinity of the egg pouches.

The following measurements, made with a Leitz compound microscope (objective 2, ocular 3), were taken from one of the egg pouches: The pouch was 2.54 mm. in length; from .43 to .54 mm. wide, the narrow measurement taken at the end with the slit; the slit itself, 1.08 mm. long. Away from the slit the pouch widens slightly, as the measurements show, and make the slit somewhat pear-shaped. The egg itself is pale, almost translucent, and appears broader at the end farthest from the slit. The measurements taken of the egg are as follows: Length, 1.81 mm.; width, .35 to .47 mm.

The apple containing the eggs was sent to Professor Herbert Osborn, who confirmed the opinion of the writer, that the eggs were those of some Membracid, and possibly those of *Ceresa taurina* Fitch.

R. L. WEBSTER, *Ames, Iowa.*

Anthrenus verbasci Linn., a common museum pest, feeds, as is well known, upon a considerable variety of dry animal and vegetable substances. April 4, 1902, two ears of corn infested by this insect were received and placed in a 2-quart Mason jar and kept tightly closed, with no moisture aside from that in the somewhat dried corn. Breeding has continued apparently uninterruptedly during a period of seven years. The bottom of the jar is nearly covered with fine, white globose particles, apparently starch grains falling from the eaten kernels of corn and a thick mass of the brown larval skins and other debris. It appears from the above that this insect is capable of breeding for an extended series of years under such adverse conditions.

E. P. FELT.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

APRIL, 1909

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints of contributions may be obtained at cost. Minor line figures will be reproduced without charge, but the engraving of larger illustrations must be borne by contributors or the electrotypes supplied. The receipt of all papers will be acknowledged.—EDS.

It is with a sense of deep personal loss and with the most sincere regret that we chronicle in this issue the decease of another leading economic entomologist. The Grim Reaper has in the past year laid a heavy tax upon our associates. Our loss in practical entomologists during this period has been equal to if not greater than that for the preceding decade. This process is bound to continue and can be partially stayed only by the recognition of our physical limitations. May we all be equally fortunate as our recent associate in winning a high place in the ranks of the profession.

There are dangers, grave dangers, in exactitude. This is particularly true where precise statements are made in a very emphatic manner. Some years ago a well known entomologist wrote: "Never use the gas stronger than 0.25 gramme cyanide per cubic foot on any kind of nursery stock." A recent bulletin changes this recommendation with no note or indication of emendation to .0088 oz. of potassium cyanide per cubic foot. This precise and somewhat remarkable recommendation appears in a bulletin ostensibly designed for practical farmers. There is no doubt that many agriculturists could figure out the proportion. There has been in the last few years an effort made to simplify our formulæ and to adapt them, wherever possible, to the requirements of practical men. The original recommendation of 0.25 gramme per cubic foot is not particularly appalling, though in a country where the avoirdupois system is in general use it occasions more or less trouble. The originator of this recommendation, we feel, would be disturbed if not startled, to find himself practically quoted as advising .0088 of an ounce. This instance appears to be a case where a man has singularly failed in adapting an otherwise sensible recommendation. It would have been plainer to have written 1 oz. to about 114 cubic feet of space, if it was consid-

ered necessary to maintain this scrupulous degree of accuracy. Furthermore, the general recommendation of most entomologists of 1 oz. to 100 cubic feet of space, a proportion abundantly justified by experience and one appealing strongly to the practical nurseryman and farmer, appears to have been entirely overlooked. Exactitude is commendable, scientific accuracy is desirable, but neither are advanced by the use of large decimal figures, unless unavoidable, in popular bulletins. We should never forget that the general adoption of recommendations by the entomologist depends in large measure upon their appealing to the practical sense of the parties charged with their execution.

Obituary

MARK VERNON SLINGERLAND

Mark Vernon Slingerland, Assistant Professor of Economic Entomology in Cornell University, died of Bright's disease at his home in Ithaca, March 10. His health had been failing for some time, but to most of his friends his death was unexpected.

Professor Slingerland was born in Otto, Cattaraugus County, N. Y., on October 3, 1864. He was a son of Jacob A. and Mary (Ballard) Slingerland. He was educated in the Otto village school and in the Chamberlain Institute at Randolph, N. Y. In 1887 he entered Cornell and in 1892 he was graduated with the degree of Bachelor of Science in Agriculture. He obtained special mention for special study with marked proficiency in entomology during the last two years of his course. From 1890 till 1904 he was assistant entomologist in the Agricultural Experiment Station, and in 1899 he was appointed assistant professor of economic entomology.

Professor Slingerland was a member of the Holland Society of New York, the American Association of Economic Entomologists (of which he was president in 1903), the Entomological Association of Washington, the National Mosquito Extermination Society and the Society of Sigma Xi (vice-president of the Cornell chapter in 1903 and 1904), and a fellow of the American Association for the Advancement of Science.

Professor Slingerland married, in 1891, Miss Effie B. Earll, who was a special student in the university in 1889–91. She survives him, with one daughter.

Although Professor Slingerland had barely reached middle life,

he was recognized as being one of the foremost workers in economic entomology, and had attained an international reputation.

He was a prolific writer. He had published many bulletins, and had contributed much to the periodical press, especially to *The Rural New Yorker*, *Country Life in America*, *The American Agriculturist*, *The National Nurseryman*, *Entomological News* and *The Canadian Entomologist*. He was a contributor to the Encyclopædia of American Horticulture and to the Encyclopædia of American Agriculture. At the time of his death he had in preparation a volume entitled "Insects Injurious to Fruit," which was to appear in Macmillan's Rural Science Series.

The position he attained was reached by untiring industry and a devotion to truth. His work was characterized by painstaking thoroughness and an absence of anything sensational. His constant aim was to determine the exact and complete truth and to present what he discovered in a clear manner. In this he was very successful, both in the class room and as a writer.

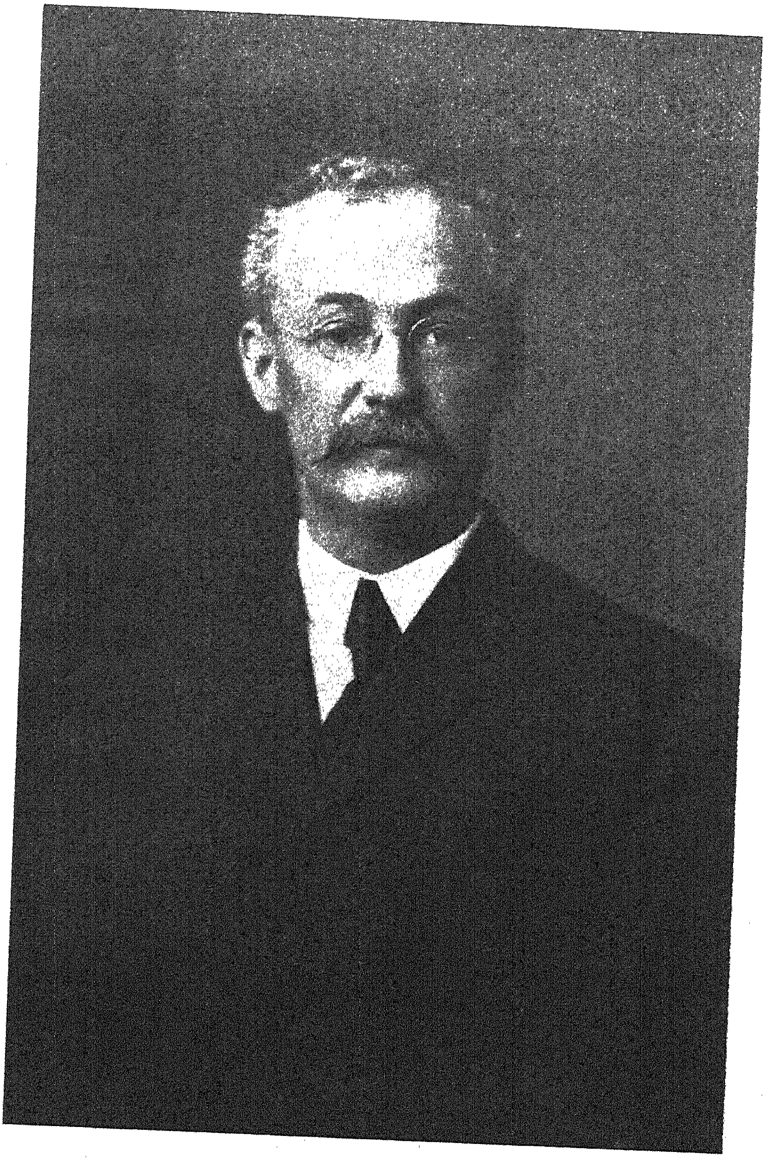
The bulletins that he published were in a marked degree monographic. Instead of writing about many insects, he selected a few and discussed them thoroughly, working up so far as possible every detail in the life-history of the species studied. It was doubtless this feature that caused his work to be so widely known in other lands. For example, his treatise on the Codling Moth was translated into Russian and published in that language.

Professor Slingerland took an active part in various scientific and horticultural societies. He was president of the Association of Economic Entomologists in 1903; chairman of the entomological section of the Association of American Agricultural Colleges and Experiment Stations in 1903; chairman of the committee on entomology of the Western New York Horticultural Society 1895–1904 inclusive; and chairman of the committee on entomology of the New York State Fruit Growers' Association in 1903.

As a teacher he was clear, direct and painstaking. He had the keenest interest in the needs of each individual student. Only a few hours before his death he discussed with a colleague the work of several of his students. Even at that hour, when it was evident to others that the end was near, his thought was not of himself but of his students.

In this manner closed the life of one who, although given but few years to work, accomplished much, and who endeared himself to others by his sterling qualities as a man and a friend.

J. H. Comstock.



M. V. Slingerland

Reviews

Report of the Entomologist, by LAWRENCE BRUNER, Neb. Sta. Brd. of Agric. Rep't., 1908, p. 287–341.

This report gives summarized accounts of a large number of injurious forms, the chinch bug, the army worm, the rose chaffer, the clover-hay worm receiving the most attention. Professor Bruner's assistant, H. S. Smith, gives a summarized account of the spring grain aphis, *Toxoptera graminum*, and discusses briefly a number of other injurious species. Mr. Myron H. Schwenk contributes a paper on the bot-flies affecting live stock in Nebraska, the ox bot-fly, *Hypoderma lineata* being discussed in detail.

Eighth Report of the State Entomologist, 1908, by W. E. BRITTON, Conn. Agric. Expt. Sta. Biennial Rep't., Prt. XI, p. 763–848.

This is another of an excellent series of reports dealing with the economic entomology of Southern New England. It is stated that the conditions are more favorable than ever for the extermination of the gypsy moth in that state. A serious outbreak by the spring and fall canker worms justifies the extended account of these insects accompanied by biological observations. A key is given for the separation of the more injurious species affecting cucurbitaceous plants, each being discussed in a summary manner. The elm leaf beetle is given a detailed notice on account of serious injuries. The value of the report is greatly increased by a large series of admirable original illustrations.

Spraying Apples, by H. A. GOSSARD, Ohio Agric. Expt. Sta. Bull. 191, p. 102–25, 1908.

This gives in detail a series of experiments designed principally to determine whether or not the drenching sprays, so much emphasized in the western states, can be profitably employed in the eastern sections of this country. The author concludes that very heavy applications of poisoned bordeaux, within a week or ten days after the blossoms fall, will do much toward producing a high percentage of sound fruit. It should be observed, however, that these results were obtained by drilled-out Vermorel nozzles and not by the Bordeaux nozzle advocated by Professor Melander. Professor Gossard finds that by omitting bordeaux from the first treatment after blossoming and using only arsenate of lead, the danger of "russeting" apples is much reduced. The practical orchardist will be highly gratified to learn that as a result of Professor Gossard's experimental spraying, a profit of $1,400 was realized.

The Boll Weevil Problem, etc., by W. D. HUNTER, U. S. Dep't. Agric. Farmers' Bull. 344, p. 1–46, 1909.

This bulletin summarizes in comparatively few pages the outcome of extended investigations conducted by the Bureau of Entomology. Under remedial measures, the author emphasizes first the destruction of the weevils in the fall by uprooting and burning plants and also destroying all trash in the cotton fields and in adjacent localities where the weevils are likely to

hibernate. Fields should be located where damage can be avoided so far as possible. The above measure should be supplemented by wide and early planting in well prepared ground. A new agricultural implement devised by Dr. W. E. Hinds and known as the chain cultivator is figured and described. This implement is designed particularly to pulverize the surface soil and at the same time to work the infested squares toward the middle of the row, where they would be more exposed to the sun and the weevils more likely to perish.

What Constitutes a Perfect Stand of Cotton When Fighting the Boll Weevil, by Wilmon Newell, La. St. Brd. of Agric. Immigra. Spec. Boll Weevil Bull. No. 1, p. 1–15, 1909.

The author calls attention to the fact that a perfect stand of cotton with boll weevil present is very different from what constituted a perfect stand before its advent, since this pest does not permit the plant to "make" during an entire season. A summary of the experiments shows that on upland prairie and bottom land during two very different seasons the average yield of closely planted cotton was 46% or 282 lbs. more per acre than in widely planted fields. This bulletin is particularly interesting, since it gives concrete statements respecting the effects following modification of agricultural treatment in an effort to control an insect pest. It is well within the province of the entomologist to determine the practical outcome of his recommendations.

The Saddled Prominent, by Edith M. Patch, Me. Agric. Expt. Sta. Bull. 161, p. 312–50, 1908.

This is a detailed account, based on the literature and original observations and with a bibliography, of *Heterocampa guttivitta*, a species which has been very destructive in Maine to both forest and fruit trees. The author in discussing the control of this species emphasizes the necessity of depending upon natural enemies, such as birds and other animals. The value of the bulletin is greatly enhanced by a series of original illustrations.

The author in bulletin 162 (p. 351–68) gives biological notes on a number of injurious species. Among the more interesting is a new spruce Tortrix, *Argyroploce abietana* Fern, a new Noctuid for apple, *Crocigrapha normani*, the European *Deilephila gallii*, *Eriophyes fraxiniphila* Hodgk. and *E. fraxini* Nal. on ash. The bulletin is illustrated by a number of original process plates. The latter would have been much improved had a better quality of paper been employed.

The Mosquitos of the Philippine Islands, by Clara Southmayd Ludlow. A Thesis Submitted to the Faculty of the Graduate Studies of the George Washington University, etc., p. 1–65, 1908.

This thesis consists of a large number of records showing the connection between the prevalence of mosquitos and the incidence of malaria. *Culex fatigans* is stated to be a host of *Filaria bancroftii* and more than suspected as a host of *Filaria philippensis*, while Ashburn and Craig claim it as a host for Dengue. *Mansonia uniformis* is given as a proven host for *Filaria bancroftii* in Africa. Four Anophelinæ, *Myzomyia funesta*, *M. ludlowii*, *Myzorhynchus barbirostris* and *M. fuliginosus*, are listed as probable malarial hosts in the Philippines. An extended bibliography accompanies the paper. The

data the author has brought together will prove of great service in determining the economic relations of a number of species.

The Tussock Moth in Orchards, by W. J. SCHOENE, N. Y. Agric. Expt. Sta. Bull. 312, p. 39–49, 1909.

This bulletin discusses an outbreak by the white marked tussock moth in orchards near Lockport, N. Y. An unusual though not unprecedented feature was the eating of the young fruit by the caterpillars. The author gives preference to the collection of the egg masses and spraying with arsenical poisons. The value of this bulletin is greatly enhanced by an excellent series of original illustrations.

The Peach Tree Bark Beetle, by H. F. WILSON, U. S. Dep't. Agri., Bur. Ent. Bull. 68, Prt. 9, p. 91–108, 1909.

This is an extended discussion based upon original investigations of *Phlœotribus liminaris* Harris. As control measures, the author tentatively advises severe trimming of all badly infested trees, burning the infested branches, and the application of a thick coat of whitewash three times each season to those slightly infested. A fine series of original illustrations adds greatly to the value of the bulletin.

San Jose Scale in Oklahoma, by JOHN F. NICHOLSON, Okla. Agric. Expt. Sta. Bull 79, p. 67–88, 1908.

This is a general discussion of the San José scale, accompanied by experimental data on methods of controlling the same. We seriously question the wisdom of advising, in a popular bulletin, .0088 of an ounce of cyanide potassium per cubic foot of space, in the face of the fact that the employment of one ounce to 100 cubic feet of space has given such universal satisfaction.

Home-Made Soluble Oils for Use Against the San Jose Scale, by J. L. PHILLIPS, Va. Agric. Expt. Sta. Bull. 179, p. 77–88, 1908.

This bulletin gives formulæ for the preparation of several soluble oils, together with the results of a series of experiments. The author advises the experimental use of these substances against San José scale and maple scale, and concludes that these mixtures can be prepared at home for about 1/3 the cost of the commercial article.

Current Notes

Conducted by the Associate Editor

Dr. Fr. Schwangart, who was recently appointed chief of the zoölogical section of the state experiment station for the study of fruit and viticulture in Rhenish Bavaria, is making an investigation of the insects injurious to these crops. He desires to secure American publications on such insects and would greatly appreciate any such publications that are sent to him. Address, Dr. Fr. Schwangart, Neustadt a. d. Haardt, 9 Maximillianstrasse, Rhenish Bavaria.

Mr. F. W. Urich has been appointed entomologist to the board of agriculture, Trinidad, British West Indies. Address, care of Board of Agriculture.

Mr. C. C. Gowdey, who was graduated from the Massachusetts Agricultural College in 1908, has been appointed government entomologist to Uganda Protectorate in Northern Nigeria, British East Africa.

Mr. F. W. Lowe has resigned from the Bureau of Entomology to accept a position with the Parke Davis Company, Detroit, Michigan.

Mr. C. B. Hardenberg, who has spent several months in Denmark, has returned to this country and is carrying on investigations on cranberry insects in Wisconsin for the Bureau of Entomology.

Mr. D. L. VanDine, who was entomologist to the Hawaiian Agricultural Experiment Station, has been transferred to the Bureau of Entomology. He will work on insects affecting sugar cane and southern field crops. Address, Dallas, Texas.

Prof. Trevor Kincaid of the University of Washington, Seattle, Washington, will sail for Europe in April. During the summer he will make extensive collections of the parasites of the gypsy moth in Russia and the material will be shipped to the Gypsy Moth Laboratory at Melrose Highlands, Mass. The investigation is being conducted under the direction of Dr. L. O. Howard.

The Ottawa Field Naturalist Club is receiving subscriptions for a permanent memorial which it proposes to erect in honor of the late Dr. James Fletcher. Suggestions as to the form of the memorial are as follows: *a*—A fountain at the Central Experimental Farm; *b*—a statue to be placed in the grounds of the new Natural History Museum; *c*—a bust or portrait to be placed in that building or at the Central Experimental Farm; *d*—To found a bursary at some Canadian university. No decision can be reached until the approximate amount of money available is known. Subscriptions may be sent to E. R. Cameron, Chairman, or W. Hague Harrington, Secretary, Ottawa, Canada.

Mailed April 15, 1909.

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OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Vol. 2 JUNE, 1909 No. 3

Proceedings of the Twenty-first Annual Meeting of the American Association of Economic Entomologists

(*Continued from April number*)

President Forbes: If there is no further discussion, the next paper will be "Notes of the Year from North Carolina," by Mr. Sherman.

NOTES OF THE YEAR (1908) FROM NORTH CAROLINA

By Franklin Sherman, Jr., *Raleigh, N. C.*

While the great majority of the complaints that have reached my office during the year just closing have been of species already widely known, yet there have been a number that have, in some way, more than usual interest.

In March a complaint (with specimens) was received from Wilmington, in the southeastern part of the state, of a species of "mite" or "flea," which was proving very troublesome by burrowing into the skins of persons. They were reported as being very abundant all over the ground, under the house, in the stables, and in chicken-coops. Specimens were at once forwarded to Prof. Herbert Osborn of the Ohio State University, who identified it as the Chicken Flea (*Xestopsylla* (*Sarcopsylla*) *gallinacea*), which he says has been troublesome in Florida and Texas for a number of years, but which had not previously been recorded north of South Carolina. Evidently this creature is extending its range and may eventually inhabit all the warm sandy coast districts. This flea was discussed in the December

issue of the JOURNAL OF ECONOMIC ENTOMOLOGY, in an article by Professor Herrick.

The Strawberry Weevil (*Anthonomus signatus*) again did serious damage in the spring in the southeastern part of our state, where the strawberry is an important crop. A number of years ago we demonstrated at least the *futility* of a number of supposed remedies, and as the favorite varieties of early berries are principally pollen-bearing sorts, growers do not take readily to the suggestion to use pistillate varieties.

The Cabbage Louse (*Aphis brassicae*) is a serious pest with us almost every spring. The insect seems to pass the winter in all stages, in small (or large) colonies on the leaves of fall-set cabbage, or on winter collards (a cruciferous crop peculiar to the south) and multiply abundantly when warm spring weather comes. We have found that complicated emulsions of kerosene, with the necessary care as to exact proportions of oil and water, are not at all necessary. Any ordinarily strong laundry soap shaved in thin pieces and dissolved in boiling water and then diluted to 1 pound of soap to 3 gallons of water is an entirely satisfactory remedy. One grower even wrote me that water filtered through a barrel of wood ashes extracted enough lye so that it was effectual, but I am not able to positively confirm this.

And right here let me say a word for simplicity. The average farmer, trucker, or fruit-grower (at least in North Carolina) is not disposed to prepare and use remedies in which special care has to be used to get proportions exact and where there are also many ingredients. We need to remember that an entomologist in the zeal of his experiment can easily procure all sorts of substances, and use methods of exactness, which the ordinary farmer will not, and in most cases cannot, use. We blissfully recommend "kerosene emulsion at the strength of 25% oil" for this, or "at rate of 15% oil" for that, and yet we must know that not one man in a dozen to whom we make these suggestions actually goes to the trouble of preparing the emulsion and testing the advice. In this I believe that my experience is not different from that of other entomologists. The simpler the process of preparing a remedy, the fewer the ingredients, and the easier they may be obtained the better, even though it may kill a less percentage of the offending insects.

In the latter part of March I received complaint of a species of "little brown cricket," which, to quote from my correspondent:

"Piles up dirt at his hole like an ant, and promises to give a lot of trouble with tobacco and other plants that are transplanted. They cut the plants off and pull them in the ground. I see that they are

more plentiful than I ever saw them before in land that I want to plant in tobacco. I have some cabbage that they are cutting off now."

A later letter from the same party said that "they live deep in the clay and come out at night to do their destruction."

Upon securing specimens it was found that the culprit was the cricket *Anurogryllus muticus,* of which we had never before had complaint and which was only meagerly represented in our collections. The burrowing habit of the species is discussed by Rev. A. H. Manee (of Southern Pines, N. C.) in the December issue of *Entomological News.*

From time to time ever since I have been in North Carolina I have heard vague reports of a "Root-louse" or "Blue-bug" which was said to attack roots of cotton. The reports always indicated that it was a serious pest, but they always reached me at such times or in such manner that no specimens were available. Only the persistency of the reports kept me from assigning them to the scrap-pile of entomological fallacies. The year 1907 brought out an unusual crop of reports, but in no case could I get specimens. I determined, however, to lay plans for at least determining the identity of the pest in 1908, and, accordingly, last spring sent out a circular letter to numerous growers saying that even the identity of the insect was yet in doubt and asking their aid in ferreting out the culprit. As a consequence we definitely determined that the species concerned is *Aphis maidi-radicis* Forbes, famous as the Corn Root-aphis of the Central States. We found, too, that in the cotton-fields of North Carolina it is commonly attended by the ant *Lasius aliena* Forst, which is considered to be a variety of *Lasius niger,* the common ant in attendance on the Corn Root-aphis in Illinois.

Aphis maidi-radicis has not heretofore been recognized as a cotton pest. Dr. Howard wrote me that it had been once reported from South Carolina on cotton,—but no published account of it had appeared. Yet I am convinced that it is (at least in North Carolina) a cotton pest of real importance and of wide distribution. I found it in cotton fields at Raleigh where the infested plants were invariably more stunted and belated in their growth than uninfested ones nearby. Growers say that these stunted plants are likely to be caught by frost before they can mature their crop.

This insect has never been reported to me as a corn pest until the past spring when one complaint was received from a section where the Cotton Root-louse is not complained of. I cannot take time and space here to discuss further the abundance and destructiveness of the pest as revealed by my correspondents, but I have scarcely a doubt

that in eastern North Carolina it is a pest of long standing, and is one of the three or four most important insect enemies of the Cotton Crop,—perhaps the most important of all.

A beetle of the family *Chrysomelidæ*, by the name of *Luperodes brunneus*, has been given the title of "The New Cotton Beetle" by Prof. R. I. Smith, in Bulletin 20 of the Georgia State Board of Entomology. The species was reported from Georgia as a pest of cotton as early as 1892, and in 1905 was sufficiently destructive to cause its discussion in the Bulletin referred to. This same beetle did similar injury with us in 1903, 1904 and 1905,—and in the present year (1908) it was sent to me with the complaint that it was doing destruction to corn by eating the silk off clean down to the husk, and devouring the pollen from the tassels. It seems to have preference for the young flowering portions of the plants which it attacks.

The Cotton Boll-weevil, while of course far from our borders at the present time, is alleged to have appeared from time to time. About 15 distinct species of insects have been sent in on suspicion of being Boll-weevil, these proving to be everything from the species of nut-weevils (*Balaninus*) to Boll-worm and adult Lace-wing flies. The campaign of education is beginning to tell, however, and each year a larger and larger proportion of the insects sent in are of the sub-order Rhyncophora, which shows that some discrimination is being used in the complaints and inquiries.

The genuine northern Army-worm (*Heliophila unipuncta*) cropped out in destructive numbers in August not far from Raleigh where it was not thought that it would normally be destructive, although the adults occur in the fall every year. The outbreak was looked into by my assistant, Mr. Z. P. Metcalf, and the interesting studies which he made on the parasitism of the species by its usual Tachinid parasite, are recorded in the December issue of the JOURNAL OF ECONOMIC ENTOMOLOGY.

The Gloomy Scale (*Aspidiotus tenebricosus*) is a pest with us on certain varieties of maple, and more than the usual number of complaints have been recorded in 1908. Studies made by Mr. Metcalf show that it is confined principally, if not entirely, to the varieties known as Red Maple and Silver Maple, while the Sugar Maple, which is the one chiefly relied on for shade in Raleigh, is not attacked.

The Elm Beetle (*Galerucella luteola*) is destructive with us every year, chiefly in the towns in the piedmont or red-clay region between the elevations of 500 and 1,000 feet. As nearly as I can ascertain the injury began to be truly serious about 1898, but the insect is now destructive in most of our larger towns in the part of the state referred to.

Finally, I would refer briefly to a work which we only began this year in definite manner. Last year at Chicago Dr. Fernald referred to the fact that despite the efforts of the entomologists, the ravages by insects continues to increase, and called our attention to the fact,—only too painfully apparent to us all,—that only a small number of our constituents really carry our recommendations into practice.

It does seem to me that we have slipped a cog somewhere when, at this late day, we still have in every state hundreds of men who depend on apple orchards for a part of their income, and who not only do not spray, but do not believe that spraying of apples will actually pay for itself in average years! These doubters are in the majority in some of our states and I believe that we owe fully as much to the duty of *proving the facts* to these men, as to discovering newer facts and principles for the more progressive minority of our people.

During 1908 we conducted apple spraying demonstrations in six different counties in North Carolina, at one place in each county. In each case three sprayings were given, the first treatment being made the occasion of a public meeting,—a sort of field institute which was advertised throughout the county through the regular Farmers' Institute organizations. A complete barrel outfit with two leads of hose, and also a complete bucket outfit were shipped from place to place. Bordeaux Mixture and Paris Green were prepared before the audience at each place, and the spraying was done before their eyes. Three trees only were used in each test, and one of them was sprayed only on one side.

We requested a report from the owners in July to show the condition at midsummer, and again in October to show the condition at apple harvest. No effort was made to work out exact details as to percentage of wormy fruit, etc. All we wanted was to demonstrate the matter to the fruit-grower from his own everyday standpoint, and this we did. Mr. S. C. Clapp, inspector of orchards for my office, did much of this work, and he visited some of the places during the summer and said the difference between the treated and untreated trees was remarkable. The five mid-summer reports were all enthusiastic, and the five autumn reports were even more so. I have recently sent out a circular to an especially prepared list of fruit-growers of our state, describing this work and giving all these reports. If this kind of demonstration work does not take a real hold among our growers and convince them of the real value of a spray pump, I shall be disappointed.

This kind of work cannot be called research and the strictly guarded Adams' fund cannot be used for it. But I submit that while we ought

to continue to seek for new facts and new principles in our science, we must strive no less to bring the already well-known and well-established facts into the common every-day practice of a much greater number of our people.

PRESIDENT FORBES: As there are two other papers on the list of a similar character, I think we will postpone discussion until after they have been presented. The next paper will be "Entomological Notes from Georgia," by Mr. Worsham.

INSECTS OF THE YEAR IN GEORGIA

By E. L. WORSHAM, *State Entomologist*

This year, as in the past, the board has devoted most of its time to apple, peach, field and garden insects. The insects infesting the peach and apple have been the most important, and much attention has been devoted to these insects. Several new insects have been reported for the first time, as doing considerable damage. The insects which stand at the head of the list from standpoint of damage done are the various scale insects.

The San José scale (*Aspidiotus perniciosus*) is the most important insect with which we have to deal, though it may be said that it is not feared now nearly so much as it was a few years ago. Its spread over the state is very slow on account of the rigid nursery and orchard inspection maintained by the State Board of Entomology. The lime-sulfur wash is still the leading spray for this scale. In orchards where this wash has been used for four or five years the scale has been greatly reduced and the condition of the orchards much improved. For the past two years the board has conducted experiments with a number of miscible oils. Some gave very good results, but it is yet too early to say how they will succeed in the commercial orchards.

The Cherry Scale (*Aspidiotus forbesi*) has been found quite numerous in some cases, though as a rule it does not do a great deal of damage.

Peach Lecanium (*Eulecanium nigrofasciatum*) has been found in a number of orchards where spraying with lime-sulfur wash was not practised last season.

The Oyster Shell Bark Louse (*Mytilaspis pomorum*) and the Scurvy Bark Louse (*Chionaspis furfura*) were found in a few orchards and on some trees they were quite numerous. The latter was found for the first time on peach trees at Waynesboro.

The West Indian Peach Scale (*Diaspis pentagona*) was found to be quite abundant in Augusta. It was found on peach, catalpa and mulberry trees, having almost killed the peach and literally covering the mulberry trees. It was found on almost all of the mulberry trees in the lower part of the city. Steps will be taken this winter to exterminate it before it spreads into the peach orchards. It was thought last season that this scale did not exist in the state, as a search was made where it was present a few years ago, and none found. Just how and when it was introduced into Augusta is not known.

In addition to the above, the following scale insects have been found: *Aspidiotus tenebricosus,* on poplar trees, Augusta, Ga.; *Ceroplastes cirripediformis,* on hackberry trees, Augusta; and a species of *Kermes* quite common on oaks in many parts of the state.

The Gloomy Scale (*Aspidiotus obscurus*) is very common on oaks and maples. In some cases it is being kept down by the red headed fungus, but maple trees in Atlanta are being killed by this scale.

Euonymus scale (*Chionaspis enonymi*) did considerable damage during 1908, killing several hedges in Atlanta and elsewhere.

The White Fly (*Aleyrodes citri*) was more numerous during the summer than ever before. In South Georgia it was quite common on orange, California privet, umbrella trees and cape jessamine. At Darien it did some damage to the sweet and sour oranges. We have no record of any remedial measures that have thus far been tried.

The Shot-hole Borer (*Scolytus rugulosus*) was quite common this last summer, and, as in 1905, was found in some cases to attack trees that, to all appearance, were perfectly sound. At Woodbury Mr. Betts had some badly infested trees, which he saved by painting the trunks and limbs with lime-sulfur wash.

The Peach Tree Borer (*Sanninoidea exitiosa*) is still a great pest in Georgia. When mounding and worming, together with the application of a caustic wash, is practised, it does but little damage, but in neglected orchards it injures many trees. This insect is better controlled than it was a few years ago, as many have learned by dear experience that the applications of repellent washes are not effective.

Numerous orchards last fall showed the work of the Peach Twig Borer (*Anarsia lineatella*), and in some cases they seemed to be doing considerable damage. In old neglected orchards they are most common. In orchards where the lime-sulfur wash is used they do little damage.

The Plum Curculio (*Conotrachelus nenuphar*) was not so abundant as in previous years. A few orchards showed bad infestation. In one peach orchard near Woodbury it destroyed about 50% of the

peaches. This orchard had not been ploughed for two years. A few large commercial orchards were sprayed this last spring for curculio, as our experiments in 1907 gave fairly good results. In these experiments we used two pounds of arsenate of lead and three pounds of lime to fifty gallons of water. Where we sprayed twice, 69% of the fruit was sound; three times, 72% of the fruit was sound, and where we sprayed four times, 75% of the fruit was sound. On unsprayed trees there were 13 to 49% of sound fruit; or on seven unsprayed trees a general average of 30% sound. In the orchards where experiments were conducted this year there was scarcely any curculio present so we obtained no results. From the work carried on for the last three years, we have decided it is not safe to spray peaches more than twice after blooming, on account of injury to the foliage and fruit.

The Codling Moth (*Carpocapsa pomonella*) was quite abundant in unsprayed orchards. We have been conducting spraying experiments for control of this insect for the past three years, and the results will soon be published in detail, so we will only mention the work briefly. It now seems that the number of broods varies each year. In 1906 two broods and a part of a third brood were found; in 1907 nearly three complete broods; in 1908 three full and a part of a fourth brood. But it must be remembered that this was an extremely early spring, fruit blooming about ten days earlier than usual, so the Codling Moth has had a long season in which to develop.

In controlling the Codling Moth the best results were secured by spraying, once before the calyx closed, and twice for the second brood. However, very nearly as good results were secured by spraying once before the calyx closed and once for the second brood. One spraying before the calyx closed gave as good results as three sprayings applied: first, as petals fell; second, before the calyx closed; and third, ten days later. In all of these sprayings we used Disparene, two pounds; bluestone, three pounds; lime, six pounds; water, fifty gallons.

The Woolly Aphis of the apple (*Schizoneura lanigera*) was present, as usual, in many apple orchards. Some growers are now using the kerosene emulsion for this insect with very good results.

The Green-apple Aphis (*Aphis pomi*) was quite abundant in a few orchards. We are now advising the use of the tobacco decoction, or 15% kerosene emulsion for fighting this louse. To beginners in spraying we usually recommend the tobacco decoction as being the least likely to injure the trees.

The Hessian Fly (*Mayetiola destructor*) was present in many wheat

fields, but the infestation as a rule was light and no great amount of damage was done. The board has been working on this insect for several years, and in September a circular was issued giving the results thus far secured. From this study it has been found that if wheat is sown from October 20th to 30th, it will not as a rule be damaged to any great extent by the fly.

The Boll Worm (*Heliothis obsoleta*) was present in many cotton fields, but no great amount of damage reported.

The New Cotton Beetle (*Luperodes brunneus*) appeared again in June, as it did last year. The first week in July Mr. A. C. Lewis examined some fields where they had been and found that the damage in no case was very great. The beetles first appeared about June 20th, and by July 1st had disappeared. So far, we have had no chance to try poison against this insect.

The Red Spider (*Tetranychus gloveri*) was present, as it is nearly every year, in several sections of the state. In a field of ten acres near Midville it did considerable damage, and in several other sections of the state great damage was reported. For this insect we recommend dusting with sulfur. Several cotton growers dusted with sulfur and with sulfur and slaked lime, with excellent results.

Specimens of the Striped Cucumber Beetle (*Diabrotica vittata*), the common potato beetle (*Doryphora 10-lineata*), and specimens of Harlequin Cabbage Bug (*Murgantia histrionica*) were frequently received by mail during summer. During summer and early fall we received letters from several parties in South Georgia stating that the mole cricket (*Scapteriscus didactylus*) was doing a great deal of damage to garden crops. Near Darien one party was using poisoned bran mash to kill these crickets, with fairly good results.

Several times during the summer letters were received from South Georgia stating that a worm was killing cow-peas. The worms ate out the heart of the stem at, or just below, the ground. In one field near Quitman two or three acres were almost completely destroyed. When we visited the fields which they had infested we found that they had disappeared and a careful inspection showed that they had gone into the ground and were found about two or three inches below the surface. It is a lepidopterous larva, but as yet we have not succeeded in getting adults to emerge.

During the summer and early fall much damage was reported from Cabbage Web Worm. A number of truck farmers in South Georgia state that it is impossible to grow cabbage, turnips and other such plants on account of this insect. Remedial measures have not been very successful.

PRESIDENT FORBES: The third paper of the series is "Insects of the Year in Iowa," by Mr. R. L. Webster.

INSECTS OF THE YEAR IN IOWA

By R. L. WEBSTER, *Ames, Iowa*

The following notes on insect injuries in Iowa during the past year are taken from office correspondence of Prof. H. E. Summers and from observations of the writer.

The English grain louse, *Macrosiphum granaria*, which was so common in Iowa and Minnesota last year, has been hardly noticeable during the past season. Early in the spring it looked as if this species might again threaten the wheat and oat crop, as it did last year. Winged forms of *Macrosiphum granaria* appeared in plots of winter wheat at Ames on April 11th. Just where these winged forms came from is unknown. Certainly they did not come from the young nymphs on the wheat, for only the very young progeny of the winged forms themselves were found. Had the species spent the winter on the grain there should have been some pupæ or older nymphs present. Moreover, the plots had been examined almost daily for several weeks preceding and no traces of aphids of any species had been found. The wind had been in the south for two or three days previous, so it is possible that the insect had been blown in. Were the time later in the spring, a migration from one food plant to another would be probable, but at this time of the season I do not know from what plant the aphid would migrate. Last year I found the winged forms of this species at Albert Lea, Minnesota, May 20th, the first appearance of the insect in any form in Minnesota that spring. These winged forms had also apparently only recently reached the grain from some other situation.

The spring grain aphis, or green bug, *Toxoptera graminum*, was also scarce in Iowa this year. Not until July 8th were any specimens found, at which time some apterous forms appeared on volunteer oats. These were found along the right of way of the C. & N. W. Railway, west of Ames. What was probably the same species was found at Council Bluffs on August 6th, but nowhere else in the state. Neither this nor the preceding species were found in southern Iowa in March, when a thorough search was made for them in fields of winter wheat.

The wheat head army worm, *Heliophila albilinea*, was very common over the state during July, especially upon timothy. The stalk borer, *Papaipema nitela*, was also common during the summer, boring in corn and oats. The clover seed caterpillar, *Enarmonia in-*

terstinctana, has been in clover fields in the vicinity of Ames. A rather uncommon plant louse, *Aphis bakeri* Cowen, has been extremely common in clover fields around Ames, causing some serious injury. One field near the college was severely attacked by this aphis. In midsummer the aphids were found on the heads and stems of the plants, but as the weather became colder they moved to the lower parts of the stems, where they were found late in the fall, attended by the large black ant, *Formica fusca*. The aphis was identified for me by Mr. J. J. Davis from specimens found on the stems of clover at Ames.

A strawberry root worm, *Graphops nebulosus* Lec., was reported from the eastern part of the state as causing serious injury to strawberry plants. This is the first time that this species has been noted as being injurious in this stage.

The woolly aphis, *Schizoneura lanigera*, has not been so common in the nurseries of the state as in previous years. It could scarcely be found during the season in nurseries which have had much trouble with this insect. Towards the latter part of July the apple-aphis, *Aphis mali*, became very numerous on apple stock in nurseries, as well as on young apple trees in orchards.

The apple leaf hopper, *Empoasca mali*, continues to be abundant in nurseries generally. In one large nursery at Charles City, in the northern part of the state, the apple stock was again attacked by this little hopper. From some observations made during the summer in various parts of the state, there appears to be five broods of the hoppers during the season, the young hoppers appearing about once a month, from May to September. The lesser apple leaf-folder, *Acleris minuta*, caused serious injury to apple stock in two large nurseries in the southwestern part of the state. A series of spraying experiments showed that this insect may be successfully controlled by spraying with arsenate of lead, the spraying being done when the insect was still in the egg stage. Spraying after the larvæ were old enough to fold entire leaves was of no practical value.

Chionaspis pinifoliae was noticed to be fairly common among evergreens in one of the large nurseries in southwestern Iowa, but did no appreciable damage. Black Hills spruce and Scotch pine were the varieties most affected. A much more serious pest, the San José scale, made its appearance in Iowa during the past year. This outbreak is treated more fully by Professor Summers in a separate article to be given at this meeting.

A cherry slug, presumably *Eriocampoides limacina*, stripped many cherry trees of their leaves in the town of Ames and vicinity. The second brood of this insect was especially numerous. Early in the

season the box elder aphis, *Chaitophorus negundinis*, was very common on the box elder trees in various parts of the state. The Buffalo tree-hopper, *Ceresa bubalus*, continues to be abundant on young apple trees in orchards, causing serious losses to young apple trees every year. One orchard of fifty acres of young apple trees at West Branch, Iowa, was severely injured by the work of this insect. Clean culture in the orchards is advised against this pest.

PRESIDENT FORBES: These three papers are now open for discussion.

MR. WASHBURN: The paper by Mr. Webster interests me because he deals with insects that we have in Minnesota. We have not been able to find the fall eggs of *Macrosiphum granaria* so far. Last year Mr. Vickery found females producing young under snow, about the tenth of December, and this year we have found the same thing. And in the insectary, where the themometer had been down to five below zero, on the same date, December 10, we found the same condition, but no eggs. We have not been able so far to find any winter eggs. We find eggs of *Toxoptera* and the question arises, is *T. graminum* really a visitor from the south? We find it away up to the northern border, and the fact that the eggs survive the winter and hatch in the spring would seem to indicate that it is with us all the time.

MR. R. L. WEBSTER: I found only the winged forms of *Macrosiphum granaria* early in the year in Iowa and Minnesota. In what form did you find it first this spring?

MR. WASHBURN: I believe they were winged forms.

MR. COOLEY: Mr. President, I have an idea that there will be found an alternation of generations in *Macrosiphum*.

MR. KELLY: I think that Mr. Cooley has undoubtedly found the eggs of *Macrosiphum* at Bozeman, Montana.

MR. SANDERSON: We got the eggs in May or June in Texas, in the laboratory, from two or three different lots, but we never could find any trace of them in the field.

MR. SLINGERLAND: I was interested in the application and mixing of kerosene emulsion. I have a few stunts that I put the boys through in the practical mixing of insecticides, and you would be surprised at the arithmetic they sometimes use in making up kerosene emulsion. I believe it is very important for them to realize the necessity for accuracy in mixing kerosene emulsion.

MR. SHERMAN: If the college student has all that trouble, how

about the actual farmers, nine tenths of whom have never been to college or high school? I make a plea right here for an easy formula that any farmer can understand and use without trouble. All these complications I am inclined to think we can do away with to a large extent, and I do make a plea for simplicity in these things.

Mr. J. B. Smith: I want to express my agreement with what Mr. Sherman has said. It is the basis of my recommendations for commercial insecticides in most cases. Most farmers would pay a little more for a commercial insecticide than to make it up themselves. It was for this reason that I urged, some years ago, upon manufacturers the preparation of an oil that would be directly soluble in water. It was for that reason that I urged manufacturers of chemicals and manufacturing chemists to attempt the preparation of a commercial lime sulfur mixture. It is for that reason that another manufacturer is attempting and has actually manufactured a soluble sulfur, that is, a preparation of sulfur in the liquid form that dissolves by simply putting it in water, without any combination with lime. It is the manufacturer of chemicals that will help the entomologist out if he is given a chance, and I recommend the manufacture of commercial insecticides, and I recommend that the farmer buy his insecticides instead of trying to make them himself, for he will certainly make a botch of it if he possibly can do it.

Mr. Slingerland: Mr. President, I feel there is a bit of danger in some of Professor Sherman's notions, especially in regard to the methods of conducting demonstration experiments. I am a firm believer in such experiments, but can we not carry on these demonstration experiments scientifically just as easily? If a farmer sees you do it a bit slovenly, he will often go to the other extreme and do it very carelessly and thus get unsatisfactory results.

A Member: Mr. President, it seems to me that kerosene emulsion has been given a rather bad reputation here in this discussion. I want to come to the rescue of kerosene emulsion as a simple insecticide. It is true that a great many orchard men fail in mixing it up, but I believe there is a chance for the elevation of the standard of our orchard men, so as to make them able to prepare kerosene emulsion and make no mistake. I have seen orchardists in one season, in one county, prepare, of their own accord largely, about 500,000 gallons of kerosene emulsion and use it successfully against woolly aphis, and I want to say that kerosene emulsion against woolly aphis, with its powers of penetration, is a splendid insecticide.

Mr. Sherman: I maintain that the majority of the people in North

Carolina and every other state will not use these complicated mixtures if they can get anything simpler.

MR. BRITTON: Mr. President, I have been much interested in this matter and about the method of getting information before the farmers who need it. In many cases our bulletins are large and are sent to certain names on the mailing list. They may reach the farmer, but he may be too busy to read them. I wish to call your attention to a simple method which has been used by us for a few years, of getting a very brief notice quickly before the farmers. We call it the "Postal Card Bulletin." It is four by seven inches in size and is made of the same stock as the ordinary postal card. The franks and address can be stamped on the face and on the back is printed very briefly the instructions that we wish to place before the farmer. In receiving this short notice he is more likely to read it and this card is especially well adapted to information of a timely nature. We don't claim any originality for it, though we have not seen anything like it elsewhere.

After transacting the usual routine business, which has already been reported, the meeting adjourned.

A. F. BURGESS, *Secretary.*

The following papers were read by title and are herewith printed in full:

OUTLINE OF AN INVESTIGATION INTO THE USE OF HYDROCYANIC ACID AND CARBON DI-SULFID GASES AS FUMIGANTS

By W. E. HINDS, *Auburn, Ala.*

The second object as stated in the constitution of this Association is "To give opportunity to individual workers of announcing proposed investigations so as to bring out suggestions and prevent unnecessary duplication of work." Although this has long been one of the primary objects in the meetings of the Association, the records show that comparatively little has been presented at the meetings along this line. The writer believes that we may very profitably discuss proposed work in these meetings, and his principal objects in presenting the present paper are three in number. First, to announce the general plan of the investigation which is now under way; second, to give occasion for a general discussion of methods, plans and objects presented, with a view of securing suggestions as to valuable experimental work which has been done by others and as to changes in present plans which may appear advisable; and third, to get an expres-

sion of the views of other workers as to the most important problems existing in this particular field of investigation.

The paper will therefore be confined to a general discussion of the project, leaving out entirely the question of results which have already been obtained. For a general understanding of the project, its subject and objects may be stated as outlined in the writer's plan of work.

Subject.—An investigation of the factors governing the production, diffusion and insecticidal efficiency of hydrocyanic acid gas and carbon di-sulfid vapor as used in economic entomology.

Object.—1. To establish a scientific basis for practical working requirements under known conditions. 2. Determination of minimum effective time and dosage required by various insect species. 3. Determination of maximum safe time and dosage usable with various plants. 4. Standardization of effective and economical formulæ for various needs. 5. Determining modifications required for effective work under varying conditions of temperature, moisture, light, insect protection and plant resistance.

Need for this Investigation.—From many points of view it would seem that this is one of the most important general fields of investigation demanding immediate attention by the economic entomologists. The general requirement for the fumigation of nursery stock before its sale and distribution has led to considerable experimental work in the use of hydrocyanic acid gas. The results obtained are in many instances indefinite, doubtful, or even contradictory, and as a rule the experimental work has been done under such conditions that no reasonable explanation of these inconsistencies can be given. The commercial value of the stock thus treated must amount to many millions of dollars annually. The cost of treatment, while small as compared with the value of the stock itself, is still a large item in the aggregate.

Besides its use for treatment of nursery stock while in a dormant condition, hydrocyanic acid gas is coming to be extensively used for the treatment of citrus trees and green house crops, involving its application to living plants which may be in an active growing condition. The reasons for susceptibility of various plants to injury by gas treatment are but vaguely understood, while their importance as bearing upon the general adoption of fumigation methods in green house and orchard work is very great.

The loss occasioned by insects to stored cereals and their products was estimated by Mr. Marlatt for 1904 as being over 100 million dollars. These losses are particularly severe with corn and various

leguminous seeds. At the present time comparatively little is being done to prevent this enormous loss. If we consider also the damage to such products in retail establishments, to household goods, tobacco products, etc., and consider also that the total crop valuation for 1908 is approximately eight billion dollars as compared with five billions for 1904, it would appear that the total insect damage for which treatment might be made by fumigation will in the three classes of nursery stock, green house crops and storage products probably amount to between 200 and 300 millions of dollars annually.

In spite of the enormous economic importance of these fumigants in insecticidal work, we must admit frankly that our use of them is very largely based upon guess work, which only too frequently results in (1) lack of insecticidal efficiency, (2) more or less injury to the plants or materials treated, (3) to unnecessary expense involved in the waste of materials and frequently also in the time given to the treatment. In case the treatment given is too weak to kill the insects for which it is applied, all of the materials and time must be considered as wasted, and similarly there is a waste in the use of a large excess above what is actually needed to kill the pests.

Even with hydrocyanic acid gas, which has been used experimentally much more than has Carbon di-sulfid, it is evident that there is a great variation in the dosage advised by different entomologists for the same purpose. No reasons for such variations are given, and only too frequently the results obtained are such as to discredit the reliability of entomological recommendations.

Particularly in regard to the use of Carbon di-sulfid it is noticeable that the great majority of recommendations are mere repetitions of what some other man has previously advised. So far as we have been able to learn, very few definite investigational experiments have been attempted with this fumigant, and unquestionably the recommendation which is generally given cannot be relied upon to accomplish the desired result.

It seems therefore that the field open to investigation is exceedingly broad and sufficiently important to command the most careful investigation possible.

Scope of Work Contemplated.—In a general way we propose to cover a fair range of subjects in the field outlined above. To learn for each fumigant under different working conditions the general limits of minimum dosage necessary to effect the destruction of various insect pests, the maximum treatment endurable by various living plants, both in green houses and out of doors; and for nursery stock, to determine the modifying influences of such obvious factors as light,

temperature, humidity, etc., and to test other factors which may seem important. The treatment of seeds intended for germination is another important phase of the work, both as regards the prevention of insect injury to the seed and the possibility of preventing this without injuring, by the treatment, the germinating power.

It will be seen from the preceding statements that the work contemplated involves more than the usual field of economic entomology, particularly in the determination of the maximum endurable time and dosage usable with various plants and in the modifications required for effective work under varying conditions of temperature, moisture, light, etc. The project involves much work in anatomical and physiological botany.

Co-operation.—Arrangements have already been made for coöperation in this botanical part of the investigation. Prof. F. E. Lloyd, whose investigations regarding the "Physiology of Stomata" have been recently published in Carnegie Institution Bulletin No. 82, has been recently appointed professor of botany and botanist to the Experiment Station of the Alabama Polytechnic Institute. His experience in this field of investigation seems to fit him in an exceptional way for this portion of the work. He will therefore undertake, in coöperation with the Department of Entomology, the investigation of the anatomical and physiological reactions of various plant tissues to these two fumigants, especially with regard to the effects upon their nutritive and respiratory functions. He will also investigate the general question of the susceptibility or resistance of common green house and other plants frequently liable to such treatment, to the effects of these gases under various conditions of treatment so as to determine, if possible, the general conditions under which fumigation for insect pests may be practised with the greatest possible safety to living plants. The ultimate object will be to establish a basis for making intelligently such necessary or desirable modifications as are demanded for successful fumigation work under varying practical conditions, so that the destruction of insect pests may be assured without endangering the life of the plant and without involving needless expense in time and materials for making the treatment.

Methods of Procedure.—The following general principles will be observed whenever possible in securing the data upon which the conclusions may be based:

1. Chemical analysis of samples of materials used in tests.
2. Establishing definitely known working conditions.
3. Securing data from experiments in which, so far as may be possible, only one factor at a time will be varied.

4. Selection of subjects to secure uniformity and to render results comparable.

5. Determination and study of the influence of important modifying factors.

6. Immediate classification of the data.

7. Statements of general results and conclusions indicated by work done and determination of their bearing upon the establishment of general principles for practical work.

In a general way the method of procedure adopted is to secure preliminary indications of results by conducting series of small tests under controllable laboratory conditions. E. g., for this work two-liter bell jars are used and the work with insects and seeds begins under the constant condition of a practically uniform strength of gas acting through a graduated series of time intervals. In this way one factor at a time will be varied until ultimately the usual, general effect of each may be established.

When these small tests have indicated some general result, tests will be made using fairly large quantities of material to determine the constancy of the results obtained. The general applicability of methods of treatment to usual conditions under which treatment may be required will then be investigated. Thus laboratory results will be checked by practical application under the conditions for which treatment might be advised.

In conclusion I may say for those conducting this investigation that we shall cordially welcome at all times criticisms showing any avoidable points of weakness in our work. We shall be glad of any suggestions as to improved methods for securing the information we need and we are especially desirous of securing the benefit of the viewpoint of others regarding the importance of various problems which may properly come within the scope of this investigation.

ENTOMOLOGICAL NOTES FOR MISSOURI FOR THE SEASON OF 1908

By Mary E. Murtfeldt, *Kirkwood, Mo.*

Throughout Central Missouri and in many other sections of the Mississippi Valley somewhat unusual weather conditions have prevailed for the past two years and it has been interesting to note the effect upon the disappearance or prevalence of injurious insects.

In 1907, from the 15th to the end of March, July heats and showers

were followed by very low temperatures and sleet and snow storms over a large part of the Middle West. In consequence of this, almost the entire tree fruit crop was destroyed. Here and there in peculiar situations a few peaches and apples matured, but in the vicinity of St. Louis there was such a dearth of the larger fruits that very few codling moth or curculio larvæ were able to find sustenance, and orchardists were to some extent comforted for the loss of their crops by the assurance that not enough of the principal pests of the more important fruits could possibly survive to do appreciable injury the following year.

But nature has many resources for man's discomfiture. True, codling moth larvæ and curculios, as predicted, were scarcely to be seen, and the winter had been favorable for the preservation of the fruit buds, but scarcely had the blossoms begun to unfold when an overwhelming outbreak of *Aphididæ* occurred. *Aphis mali* on apple and quince, *A. prunifolii* on the plum, *Myzus persicæ* on the peach, in such numbers that the blossoms were dwarfed and tarnished and the young leaves so distorted and crumpled that the trees had the appearance of being blighted. Comparatively little fruit set, even on trees that were sprayed, and very few or no perfect fruits developed on apple, pear or quince trees. The scanty crop of peaches—reduced chiefly through the extensive injury to the foliage—was of better quality than that of the pip fruits, and this was also the case with such of the cherries and plums as escaped the brown-rot.

In the vegetable garden also, the same class of insects rendered young plants of cabbage, mustard, lettuce, and later melons and cucumbers, objects of abhorrence with the piled-up myriads of sap suckers clustered on leaf and stem and blossom. In the flower garden scarce a shrub, herbaceous, perennial or annual, afforded any satisfactory blossoming or luxuriant growth throughout the season on account of the extraction of its vital juices by aphids, green and yellow, brown and red.

This would not have been the case had not almost constant and torrential rains prevailed throughout May and June, undoubtedly drowning out the natural enemies and checks of these pests. It was not until the middle of July or later that I began to note on the clusters of aphids some Coccinellid, Syrphus and Chrysopa larvæ and during the succeeding late summer and autumn drought these multiplied and proportionately aphids diminished. *Aphidius* and *Aphelinus* species did not become at all numerous, to judge by the comparatively few parasited specimens observed.

At present (December 20) very few aphid or winter eggs are to

be found even on the most profusely infested trees and plants, and fruit growers and gardeners are hoping that the scourge has run its course for the present.

[This concludes the list of papers read by title.]

NOTES ON INSECTS AFFECTING THE COCOANUT TREES IN THE SOCIETY ISLANDS

By R. W. Doane, *Stanford University, Cal.*

In a previous issue of this Journal, 1: 341, I have given a few notes on *Aspidiotus destructor* and its work on the cocoanut trees in these islands. While this insect is responsible for the greatest injury to the trees, there are several others that are of more or less importance. Among the scale insects *Hemichionaspis aspidistræ* ranks next to *A. destructor* in numbers and probably in amount of damage done. The two are usually found together on the leaves and fruits. *H. aspidistrae* occurs on all parts (except the trunk and roots) of both the old and young trees, the white scales of the males often forming white patches that nearly or quite cover the leaflets on many of the leaves. But it is on the nuts that it is most abundant and most conspicuous. The husk of both the young and the old nuts are often almost completely covered with it. On account of this habit of attacking the husks of the nuts it is not as injurious as it would be if it confined its attention to the young tender leaves. I also collected it and had it sent to me from several of the islands of the group on a number of unidentified weeds and shrubs. Everywhere it is abundantly parasitized by a small chalcid, but I did not succeed in rearing the parasite. *Lepidosaphes gloveri* is often very abundant on the bases of the older leaves, but as long as its attacks are restricted to this part of the tree the damage done is not very great. It is everywhere badly parasitized. On some leaves practically all of the scales showed the small round hole where the parasite had escaped. On the young tender unfolding leaves of many of the trees, both old and young, are to be found large colonies of *Pseudococcus pandani*. Some of the young trees are seriously injured in this way, for as fast as the tender leaves break from their sheath the insects attack them and when abundant produce a considerable amount of honey dew. This mixed with the white flocculent excretion collects in large drops and masses in the folds of the leaves around and below the colony. No

natural enemies of these insects were observed, but the fact that they are only to be found on protected parts of the tree would indicate that some predaceous form keeps them from spreading to more exposed parts. It is possible that the small skinks and geckos that are so abundant on many of the trees snap up any of the insects that are accessible. What seems to be the same species of mealy-bug occurs abundantly on the *Pandanus.* These are often in somewhat more exposed places and I have seen the larvæ of lacewing flies feeding on them. It is very likely that these larvæ attack the mealy-bug on the coacoanut trees as well. This is probably the same species of *Pseudococcus* that is reported as doing considerable damage to cocoanut trees in other groups of the South Sea Islands.

Toward the base of many of the older leaves on some of the trees may be seen small holes, from which flows a resin-like exudation. Often this has issued to such an extent that the whole lower portion of the leaf is covered, or it collects in lumps on the leaf below. Often bits of leaf-fiber and larval castings are mixed with the exudation. Around these holes the tissue of the leaf is more or less blackened and decayed. Two different types of these holes may be found, usually on the same tree, distinguishable principally by their size and the amount and extent of the injury. Both are made by the larvæ of weevils; a large one, the adult of which is about 13 mm. in length, and a smaller one about one half the size, kindly identified by Mr. Schwarz, through Doctor Howard, as *Sphenophorus obscurus* Boisd. and *Calandra taitensis* Guérin. The larger larva usually works closer to the base of the leaf, often killing the leaf by burrowing all through it. Sometimes the larva will keep close to the edge of the leaf or go only as far in as the center, boring a tortuous chamber from ½ to ¾ an inch in diameter. The burrow is usually filled with the chaff and castings and the larva is usually found at the upper end of the burrow. Often from the blackened portion of the infested leaf the resinous exudation will be issuing in several places, making it appear that several larvæ are at work in the same leaf. This is sometimes the case, but a single larva may bore along a leaf stem for 12 to 15 inches, causing the exudation to flow in abundance from several openings and making many large discolored spots, beneath which the tissue is soft and decayed. The older leaves are usually attacked. After attaining its full growth the larva bores close to the surface and constructs a rude oval cocoon out of the fiber that it has been eating and transforms to the pupa stage, from which it later issues as the adult beetle. These cocoons may usually be found quite abundantly in the chaff at the base of old leaves or in the old leaves. In some in-

stances the larva bores into the trunk of the tree for a short distance where the broad leaf-base joins the tree. In one instance I found the beetle quite abundant in and around the growing tip of a young tree that was dying, whether as a result of the work of the beetle or from some other cause I was unable to determine.

The smaller weevil, *C. taitensis,* seems to be much more abundant and on account of its habits is perhaps more injurious than the larger species. It is found most commonly boring into the edge of the base of the leaf-stem. Its presence is indicated, as with the larger species, by the presence of a gummy exudation mixed with castings. These are often in the shape of long twisted strings, 1/4 to 1/2 inch long. As the larvæ do not work as deep in the tissue of the leaf as do those of the larger species, the damage here is not very great, but when they work further out at the base of the leaflets many of the leaflets are destroyed.

A still more serious damage is done where the larvæ attack the spikelets, killing them at the point of attack and working toward the base. As long as they confine their work to the portion of the spike having only the male flowers the damage is not serious, because the number of these flowers is so great. But when they attack the spikelet below the female or fruiting flower, the young fruit is killed. After the larva has become full grown it makes for itself a rather long cell, with a very thin wall on one side, and, without making a cocoon, changes to the pupa, from which, later, the adult emerges and breaks through the thin wall of its cell.

Another insect that is doing much damage to many of the cocoanut trees on all parts of these islands is the larva of a small moth that works on the underside of the leaflets, eating away the lower surface and causing the whole leaflet to turn brown and die. Often a large portion of the leaf is thus destroyed, giving the whole tree a very ragged appearance and of course doing considerable damage when many leaves are affected. The larva spins a thin, protective net of silk as it feeds. Along the midrib or at the base of the leaflet a denser web is formed, to which the larva, by a peculiar jerky motion, retreats when disturbed. A very few pupæ were taken, but I was not able to rear the adult moth, so I cannot identify the species.

There is another small moth larva that may prove to be of considerable importance on account of its habit of attacking the male flower buds as soon as they are exposed by the opening of the spathe. Many of the spikelets are nearly or quite stripped of their buds before the flower opens. The larva works just at the base of the bud, usually inside, often extending its work out along the stem for a short dis-

tance, and sometimes boring into the spikelet. In some instances the web may connect two or three near-by buds, the larva resting between or in one of them. The larvæ when disturbed or driven from their retreat move along the spikelet with a quick, jerky motion. No adults were reared, so I do not know the species.

On some of the trees, where male spikelets were in bloom, the spike would be literally covered with two species of Oedemerids, *Ananca livida* Fab. (Oliv.), and *A. collaris* Sharp (also identified by Mr. Schwarz), the former being more abundant. They were feeding on the pollen and where a spike was badly attacked practically all the pollen was destroyed. This might prove to be of some importance if many trees were attacked. Mr. Schwarz points out that the members of the closely related American genus *Oxacis* breed in rotten wood and that the imagoes of some of the Florida species congregate on the flowers of palm trees. A thorough study of the insect enemies of the cocoanut trees in this region would doubtless result in a considerable saving to the planters.

RECENT WORK IN INSECT BEHAVIOR AND ITS ECONOMIC SIGNIFICANCE[1]

By William B. Herms, *Assistant Professor in Entomology, University of California*

Animal behavior has been the subject of much investigation during the past ten years, with the purpose of analyzing the organism's method of orientation to a stimulus and the method of locomotion toward or away from such a source of stimulation. Paper after paper has been published, affording considerable information on the subject,—the "tropism" scheme, the "trial and error" method, and the "random movement" method have been advanced and criticised, internal factors and external factors have been considered, sundry methods of experimentation have been applied,—but little has been done with an economic aim. Certainly a narrow viewpoint would be evident were we to expect an immediate economic return for every new effort in science; it must be considered that many if not all applied sciences have found their origin in pure science, and a heedless attitude toward the same may result in actual hindrance to progress. But the agriculturist who has to deal at first hand with the pests of the orchards and of the field may well ask the question of the student of animal

[1]A paper presented at the Watsonville (California) Entomological Conference, Aug. 25, 1908.

behavior, "Can your science lend us aid in the warfare against our enemies?" None present this afternoon will doubt for an instant the commercial importance of such biological sciences as zoölogy, entomology and botany, even at this time when the economic department of these subjects is still in its infancy, and it is safe to say that the next few years will prove the same for the science under consideration.

It is my purpose in this paper to first point out the scope of "Animal Behavior" as accepted by the more progressive group of workers in this field led by such investigators as Parker, Jennings *et al* on the one hand, and Yerkes, Watson *et al* on the other. As just indicated, it should be understood that there are really two more or less distinct groups of workers in the science of animal behavior: the one concerned mainly with the external factors—the comparative physiologists; and the other group concerned mainly with the internal factors—the comparative psychologists.

In the second place I wish to point out some of the more recent work in *insect* behavior, treating this phase from a more or less critical standpoint.

I Scope of Animal Behavior

The behavior of anything, whether organic or inorganic, rests upon activity; the activity of *living* things is determined by the interaction of two classes of determining factors, viz.:

1. Quality of the protoplasm=internal.
2. Quality of the environment=external.

By any change of the external agencies that act upon the organism, the latter is stimulated, because irritability is a characteristic of protoplasm. Therefore a *stimulus* may be defined as any change of the external agencies which act upon the organism, *e. g.*, alteration of temperature, moisture, amount of food, etc.,—in short, the addition of a new factor, or the increase or decrease in degree of an old factor. *Stimulation* is the result of contact of a stimulus upon the living substance, and the fact of stimulation is made obvious by movement or by a reaction of some kind. Stimuli may vary enormously in extent as thermal and chemical stimuli, but the limits within which these conditions act as a stimulus are very narrow, and the total range of a stimulus has not equal importance. The animal lives better near normal conditions than near either extreme. Every organism is adapted so that it will live best at a certain degree of stimulation, *i. e.*, optimal—at the minimal or maximal death ensues.

The reaction of an animal is carried out through the inter-relation

between the sense organs (receptors), the central nervous system and the muscles or glands (effectors). Among the most intangible phenomena that we have to deal with are sensations, yet the old classification of sense organs is based on such internal conditions, and consequently the usual classification, that of sight, smell, touch, hearing and taste is quite unsatisfactory. Because of the inadequacy of the subjective basis for classification, the tendency is to transfer the treatment to an objective basis.[1] The external world forms a basis for the source of stimuli or energy change. On this basis sense organs are grouped into only two general classes, viz.: 1. Sense organs stimulated by ether changes, such as light, heat and electricity. . 2. Sense organs stimulated by material changes, sub-divided into two subclasses: *(a)* Physical, organs which receive prolonged contact stimulation, such as touch and pressure, and organs which receive vibratory contact, commonly called sound organs (hearing); *(b)* Chemical, organs which serve as receptors of chemical stimuli, taste and smell.

Thus the weight is thrown on the external world, we are not limited to sensations, and, what is most important, a basis for measurement may be secured,—*e. g.*, light intensity can be measured in terms of candle meters and can be controlled; chemical solutions can be measured in degrees of concentration and can be controlled. And here is where the great difference exists between earlier and more recent work in animal behavior. Accuracy of measurement is the great criterion by which modern work is judged, and this involves not only a knowledge of zoölogy or entomology and their histological methods, but also a knowledge of the physics and chemistry of the stimulus employed. The following extract taken from the editorial notes of a recent number of the Experiment Station Record[2] is quite apropos at this time:

"The advantage of agricultural science over the individual sciences as applied to agricultural problems should lie in its special point of view and in the bringing of various sciences to bear on these problems. For its purposes the boundaries of the primary sciences are overstepped. The investigator in that field is not restricted to a single science, but employs the teachings and the methods of several, as his case requires, acting as a connecting or coördinating agent. This cosmopolitan relationship calls for widespread familiarity with the whole field of natural science. Its danger is too close specialization and disregard of everything in the pure sciences which does not bear directly and quite immediately on the field of agriculture. Such a course tends to narrowness and to superficiality on the part of its adherents."

2 Recent Work in Insect Behavior

As numerous as this group of animals is, comparatively little has been done on them by workers classed as students of animal behavior, and furthermore that which has been accomplished has been directed largely toward species of relatively little economic importance. The pomace fly (*Drosophila ampelophila*) has received much attention in the Harvard zoölogical laboratories, chiefly because of its availability during the winter months, since it is easily reared in artificially heated rooms. Carpenter[3] has made a study of the reactions of this fly to light, gravity and mechanical stimulation. The fly moves toward a source of light, *i. e.*, light has a directive effect, but this is not apparent until a sufficiently powerful kinetic stimulus (light or mechanical) has been exerted to induce locomotion. When very high intensities are used, *e. g.*, a 250 c. p. arc light, at 40 cm., the directive effect of the light is apparently inhibited. Continued exposure to direct sunlight caused many insects to come to rest in the least brightly illuminated regions and with the heads away from the source of light. This last fact is explained because this is the position in which the least light enters the eyes, and in which, as a consequence, the kinetic stimulus is least. The great number of these flies around cider presses, orchards and packing houses where fermenting fruit is often found in quantities, leads one to wonder how these creatures find these localities. It is, of course, a well known fact that these flies deposit their eggs in fermenting fruit, and that the larvæ or maggots feed and develop in such matter. The most natural inference (because these insects bear conspicuous compound eyes) is that the food is located by means of the sense of sight, but as a matter of fact "they find their food with great certainty even in the dark." This led Barrows[4] to take up an investigation of their reactions to "odorous substances." The flies were tested by accurate methods to various intensities of substances commonly found in fermenting fruit, such as ethyl alcohol, acetic and lactic acid, and acetic ether, each used separately and also mixtures of them. The intensity of concentration was known in each, an important consideration in such work. It was found that the optimum strength of ethyl alcohol and acetic acid is 20 and 5 per cent respectively. It was further ascertained that cider vinegar, fermented cider and California sherry contain alcohol and acetic acid in percents very close to the optimum strength. By experiment it was next determined that the sense of smell by means of which food is found, is located in the terminal segment of the fly's antenna.

The eyes of insects have long been studied for their structure and physiology and one of the most important studies recently made on the image-forming powers of eyes was carried on by Cole.[5] This investigator experimented on *Vanessa antiopa* (the mourning cloak butterfly), *Ranatra* (the water scorpion), *Tenebrio* (the meal worm), and again the pomace fly, also several other animals. This work, though not conclusive for some of the species studied, provides conclusive evidence that at least the mourning cloak butterfly and the water scorpion of the animals possessing compound eyes have image-forming powers. This evidence is further augmented by recent experiments by the writer[6] on two common species of flesh-flies, *Lucilia cæsar*, and *Calliphora vomitoria*, with the further evidence that the eyes of these flies have this power not so well developed as the butterfly, which is probably correlated with differences in habit, the flesh-flies being more dependent on their sense of smell. Parker[7] in his investigation of the light reactions of the mourning cloak butterfly, discovered that it reacts to bright patches of sunlight. The larvæ of *Corethra plumicornis*, a short-beaked mosquito, have received the attention of various investigators, among them Harper,[8] who has investigated experimentally their daily depth migration. Ants have formed the basis of a number of classical works represented by Lubbock, Forel and Wasmann, and still these interesting creatures receive the attention of many recent investigators with results fully as significant, due to the application of new and more accurate experimental methods. Much of this work has however taken the form of comparative psychology, as has the splendid work of Turner.[9] The investigations of Fielde,[10] and Fielde and Parker,[11] have afforded us much information on the sensory reactions of these organisms.

The above references have been made to afford some idea of the nature of the work carried on by students of animal behavior, and it will be seen that that which concerns the economic worker most is the experimental method applied, since the species studied have little or no significance from the economic standpoint. But it is this experimental method, carrying with it utmost accuracy, that may well concern us who are interested in the control of insect pests. What is most needed at this time in the study of economic species,—granting the importance of a knowledge of life histories,—is a knowledge of its reaction to a given stimulus (the optimum stimulus) not only at one period of its life history but throughout every active period, because the reaction of an animal at one stage may not be its reaction at another, *e. g.*, the flesh-fly, *Lucilia cæsar*. Though others supposed its reactions to light to be of a rather simple nature, which is

largely true for a given period. its reactions throughout the life history of the individual show progressive change, viz.: first, during the feeding period the larvæ as a body react positively to artificial light, though as individuals they are apparently always strongly negative; secondly, the migrated larvæ (in the pre-pupal period) are uniformly negative; and finally, though the larvæ pupate as negative organisms, they emerge in a positive state. (In this connection one should consider the fact that the larvæ are eyeless creatures, while the adults possess well developed compound eyes.) The following table shows this range of reaction of *individuals* to a given stimulus, light of 0.56 C. M. intensity.

TABLE 1

Summary of reactions of Lucilia cæsar (Lot No. 10) at different ages to directive light (0.56 C. M.). Based on ten larvæ given five trials each to an exposure of thirty seconds.

REACTION

DATE—1907.	AGE.	STAGE.	TRIALS.			PERCENTAGE.		
Dec. 5, a. m.	Birth.	Just hatched.	a 8 b 1	5 11	7 8	a 40 b 5	25 55	35 40
" 6, 10:45 a. m.	24 hours,	Feeding.	6	31	13	12	62	26
" 7, 10:35 "	48 "	"	3	36	11	6	72	22
" 8, 10:35 "	72 "	"	1	42	7	2	84	14
" 9, 10:45 "	96 "	"	0	44	6	0	88	12
" 10, 10:35 "	110 "	"	0	47	3	0	94	6
" 11, 10:35 "	6 days.	Prepupal.	1	47	2	2	94	4
" 12, 10:40 "	7 "	"	2	48	0	4	96	0
" 13, 10:35 "	8 "	"	0	50	0	0	100	0
" 14, 10:30 "	9 "	"	3	46	1	6	92	2
" 16, 10:30 "	11 "	"	2	28	0	7	93	0
" 17, 10:30 "	12 "	"	0	20	0	0	100	0
" 18, 10:30 "	13 "	"	0	10	0	0	100	0
" 26–30.	25 "	Imago.	27[1]	1	0	97	3	0

A further question which must be carefully considered is, Does the behavior of the organism vary with the intensity of the stimulus and what is the variation? This is again illustrated by another table (Table 2), which shows the reactiveness to directive light for various intensities of two species of flesh flies. Here is also illustrated the difference in reactiveness of two related species to exactly the same

[1] This aberrant reaction was on the part of an individual whose wings did not spread and was consequently forced to creep. All other adults first perched on the edge of the vial in which they were retained and then flew toward the light.

intensity of stimulation, *i. e.*, an examination of the following table reveals the fact that *Lucilia cæsar* is a fly which is more reactive to light in the larval stage than is *Calliphora vomitoria*, which was also experimentally shown for the adults.

TABLE 2

Reactiveness to directive light through the general range of intensity for migrated larvæ of Lucilia cæsar (Lots No. 6 (A) and No. 25 B), and of Calliphora vomitoria, (Lot No. 24.)[1]

REACTIONS

Source of Light.	Intensity in C. M.		*L. cæsar.* P.	N.	I.	*C. vomitoria.* P.	N.	I.
Diffuse daylight.	?	(A)	0	50	0	0	50	0
Arc light.	800.	(A)	0	50	0	0	47	3
Incandescent light.	0.56	(A)	1	44	5	3	44	3
" "	0.1764	(A)	5	37	8	8	32	10
" "	0.0342	(A)	6	35	8	2	35	13
" "	0.00705	(B)	0	33	18	7	24	19
" "	0.00176	(B)	2	28	20	8	17	25
" "	0.00063	(B)	5	14	28	9	11	30
" "	0.00007	(A)	1	3	46	5	4	41
....	Total darkness.	(A)	2	2	46	5	1	44

It should be explained that the study of the flesh-flies was undertaken by the writer [12] because of their importance as scavengers of lake beach debris, and were used later as favorable organisms for detailed observation with regard to light reactions.[6]

In conclusion I cannot refrain from expressing my regret that there are students of animal behavior who know only the laboratory aspect of animals, who seem to believe that it is unbecoming to carry on field observations. Plucking an animal from its native soil without a thought of its natural environment and hustling it into the laboratory and subjecting it there to all manner of stimuli, often of unknown intensity and quality, is certainly not a commendable method of procedure. The normal environment and normal behavior of an organism should have the experimentor's closest attention, in order to aid in a correct interpretation of the phenomena observed under experimental conditions. A combination of field and laboratory

[1] The reactions (P. N. I. = positive, negative and indifferent respectively) are based on the movements of ten larvæ given five trials each at an exposure of thirty seconds. Between trials, taking larvæ No. 1 first, then No. 2, etc., through the series, each individual was kept separate in a closed receptacle.

observation affords in the writer's estimation the most satisfactory basis for experimental work. Having determined the physiological differentiation of the organism, a histological test for structural differentiation of sense organs can well be undertaken, and with these two factors well in hand we have a splendid basis for practical control.

References Cited

1. **Beer, Th., Bethe, A.,** and **Uexkull, J. V.,** 1899. Biol. Centrbl. vol. 19, No. 15, p. 517–521.

2. ——— Experiment Station Record, 1908, vol. 19, No. 11, p. 1001–1005.

3. **Carpenter, F. W.,** 1905. The Reactions of the Pomace Fly (*Drosophila ampelophila* Loew) to light, gavity and mechanical stimulation. Amer. Nat., vol. 39, p. 157–171.

4. **Barrows, W. M.,** 1907. The Reactions of the Pomace Fly (*Drosophila ampelophila* Loew) to odorous substances. Journ. Exp. Zoöl., vol. 4, No. 4, p. 515–537.

5. **Cole, L. J.,** 1907. An Experimental Study of the Image-forming powers of various Types of Eyes. Proc. Amer. Acad. of Arts and Sciences, vol. 42, No. 16, p. 335–417.

6. **Herms, W. B.,** 1908. The Reactions of Sarcophagid Flies to Light. (In press shortly.)

7. **Parker, G. H.,** 1903. The Phototropism of the Mourning-cloak Butterfly, *Vanessa antiopa* Linn. Mark Anniversary Volume, p. 453–469.

8. **Harper, E. H.,** 1907. The Behavior of the phantom larvae of *Corethra plumicornis*, Fabr. Journ. of Comp. Neurol. and Psychol., vol. 17, No. 5, p. 435–456.

9. **Turner, C. H.,** 1907. The homing of Ants: An experimental study of ant behavior. Journ. of Comp. Neurol. and Psychol., vol. 17, No. 5, p. 367–434.

10. **Fielde, Adele M.,** 1901. Further study of an Ant. Proc. Phila. Acad. Nat. Sc., vol. 53, p. 521–544.

    ——— 1904. Effects of Light-rays on an ant. Biol. Bull., vol. 6, p. 309.

    ——— 1904. Observations on Ants in their relation to temperature and to submergence. Biol. Bull., vol. 7, p. 170–174.

    ——— 1905. The sense of smell in ants. Ann. N. Y. Acad. Sc., vol. 16, p. 304.

11. ——— and **Parker, George H.,** 1904. The Reactions of Ants to material vibrations. Proc. Phila. Acad. Nat. Sc., vol. 56, p. 642–650.

12. **Herms, W. B.,** 1907. An Ecological and Experimental Study of Sarcophagidæ with reference to lake beach debris. Journ. Exp. Zoöl., vol. 4, No. 1, p. 45–83.

QUACK GRASS (AGROPYRON), A HOST OF THE HESSIAN FLY[1]

By Paul Hayhurst

As far as we know it has not yet been definitely proved that the Hessian fly can breed on any grass besides its three well-known hosts, wheat, rye and barley, although many attempts have been made to shed light on this question. It was, therefore, with unusual interest that puparia, apparently of this species, were accidentally discovered in quack, or couch-grass, *Agropyron repens*, at Forest Hills, Mass., Nov. 8, 1908. They were particularly numerous on a small piece of cultivated land where this grass had sprung up in early autumn. It must, therefore, have been especially suitable for oviposition when the fall brood of adults were flying. Puparia were found at several other points in this neighborhood, but never in the larger, tougher plants. They were all embedded in the stems just above the roots like the true Hessian fly, and the injured plants showed precisely the same effect. There was no stubble or volunteer grain near the infested grass, and the nearest field of grain was a little rye about a mile east, which was, therefore, not in the direction of the prevailing winds. The U. S. Weather Bureau states that these were S. W. during September, 1908. It seems improbable that this attack on the quack was accidental from neighboring grain fields.

We thought it best to rear the adults and to test their specific identity by breeding them on wheat. Acordingly 65 specimens were collected from the quack and placed in a vivarium. On Dec. 10th adult males and females began to emerge. A number of these were enclosed over young growing wheat. Eggs were laid freely in the furrows of the dorsal surface of the leaves in the usual way of the true Hessian fly. The reddish larvæ hatching from these eggs stationed themselves in the stems just above the roots, and adults of both sexes emerged the following February. Specimens of these flies together with their parents reared from quack were sent to Doctor Felt, an eminent authority on the Cecidomyiidæ. He kindly replied as follows: "I have studied the material . . . and I see no reason for not regarding the Mayetiolas reared from *Agropyron repens* taken in the field, and the descendants therefrom bred on wheat in the insectary, as other than the Hessian fly, *Mayetiola destructor* Say."

Doctor J. Portschinsky, Chief of the Bureau of Entomology of the

[1]Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 4.

Ministry of Agriculture of Russia, St. Petersburg, wrote to us as follows relative to this species on quack in his country: "Several Russian naturalists (Portschinsky, Jaroschewsky, Philippiew, Lindemann) have several times found the larvæ of this species in numbers on the stems of *Agropyron repens*. We consider this plant as natal for this insect."

Prof. F. M. Webster wrote to the author in these words: "With regard to your breeding Hessian fly (*Mayetiola destructor*) from quack grass, I will say that it seemed to breed freely in *Agropyron* in Kansas last year, very evidently originating from serious outbreaks of the pest in adjacent fields of wheat. In order to make sure, the species will need to be bred from *Agropyron* to wheat and those from wheat bred from *Agropyron*. When this has been done, all obscurity, it seems to me, relative to the occurrence of Hessian fly in grasses will be swept away."

We believe that the determination of specimens taken in native grasses has never before been corroborated by biological criteria. We can now say with certainty that the true Hessian fly can breed freely in quack at least under some conditions. It is therefore important to know more about these conditions. Evidently they will breed most readily in grass that is young and tender in the fall at the time of oviposition. Since quack is a noxious weed almost everywhere in the United States, it is unfortunate to have to regard it as even a possible source of infestation. It is not likely, however, that the fly is usually plentiful enough in quack to make it a dangerous source of trouble from a practical point of view, except possibly in rare instances. If it were generally so numerous in this grass, one would expect it to be well known at this late date.

The question can now be raised whether quack was the original host of the Hessian fly which was able to develop more abundantly on the cereals after their introduction by man. If this should be so, then the history of this insect would be a parallel case to that of the Colorado potato beetle. If *Agropyron* could be found infested with Hessian fly in regions remote from cereal crops, we would consider it the original host. In this case the insect might have been native anywhere in the temperate regions where the circumpolar *Agropyron* grows. There would then be no mystery about its introduction in America. But this must be considered a profitless subject for speculation, unless the nativity of the insect on quack should be tested as above suggested.

The following is a brief summary of the observations by others on the supposed Hessian fly in native grasses:

In 1887 Koebele found puparia in *Elymus americanus*, *Agrostis* sp. *Bromus ciliatus* and *Agropyron* sp. in California. Flies reared from these were sent to Washington where they were considered the true Hessian fly. The determination of the *Elymus* material was later disputed by Mr. Theo. Pergande, of the Bureau of Entomology, on some small structural differences between the specimens and some others reared from wheat.

In 1888 Lindemann reported considerable infestation in timothy and quack in the Russian governments of Tambaw and Woronesh, but he does not say that he reared the adults.

In 1897 Marchal repeated Forbes' experiments, likewise with negative results, on these grasses: *Bromus pratensis*, *B. mollis*, *Dactylis glomerata*, *Festuca pratensis*, *Alopecurus pratensis* and *Holcus lanatus*. He demonstrated clearly by biological experiments that *Mayietiola avenæ* (Marchal) infesting oats in France was specifically distinct from *M. destructor* (Say). He called attention to eight other species belonging to allied genera that attack native grasses. He thus showed the necessity of verifying the determination of supposed Hessian fly puparia in indigenous grasses by the "criterium biologique," and he asserted that evidence of this character was still lacking in all the work done on this insect.

In 1898 Osborn adopted Marchal's position as final and pointed out that over the immense wheat-growing sections of the United States no record exists of an infestation in native grasses.

In 1906 Gossard and Houser found a few eggs laid voluntarily on the following grasses near wheat fields in Ohio: *Festuca pratensis*, *Arrenatherum avenaceum*, *Poa pratensis*, *Lolium perenne*, *Dactylis glomerata*, *Bromus inermis*. Very few eggs were laid on each grass, and none developed except on one plant supposed to be a *Lolium*, but never satisfactorily determined. Flies were induced to oviposit in vivaria on fox-tail, orchard grass, timothy, redtop, blue grass and wild rye (*Elymus canadensis*) but none of the larvæ developed.

It will thus be seen that the Hessian fly positively determined from the adults has been secured from quack in California, Kansas and at Forest Hills, Mass. It seems, curiously enough, that *Agropyron* (*Triticum*) *repens* has never been used in breeding experiments, although it is closely related to wheat (*Triticum vulgare*) and is everywhere available.

The writer takes pleasure in acknowledging Professor Wheeler's kind suggestions relating to these observations.

The following notices on the Hessian fly are supplemental to Doctor Felt's bibliography:

Bruner, L., and **Swenk, M. H.** Some Insects Injurious to Wheat during 1905–1906. Neb. A. E. S. 96, 1907, Hessian fly, p. 3–24; figs. 1–4 and col. pl.

Desprez, F. Jr. Agric. Prat. (n. ser.), vol. 8, No. 36, 1904, p. 319–320. (Exp. Sta. Record, vol. 16, p. 279.)

Felt, E. P. The Hessian Fly. Seventeenth Rept. St. Ent. N. Y., N. Y. St. Mus. Bull. 53, 1902, p. 705–730. Bibliography, p. 725–730.

Fletcher, J. Reports of the Entomologist and Botanist. Canada Exper. Farms, Rept. for 1899, p. 163–170, figs. 2–6; 1900, p. 197–201, figs. 1–3; 1901, p. 214–217, figs. 1–2; 1902, p. 173–174, fig. 1.

Garman, H. Hessian Fly Experiments. Ky. A. E. S. Bull. 103, 1902, p. 231–244.

——— The Hessian Fly in 1902–1903. Ky. A. E. S. Bull. 111, 1903, p. 213–224.

Gossard, H. A., and **Houser, J. S.** The Hessian Fly. Ohio. A. E. S. Bull. 177, 1906, p. 1–39, text-figs. 1–2, map and pl. opposite p. 16.

Lampa, S. För Sverige nya skadedjur. Entom. Tidskr., vol. 19, 1898, p. 144.

Marchal, P. La Polyembryonie Spécifique. *Polygnotus minutus* (Lindm.) Arch. Zoöl. Exper. (4)., vol. 2, 1904, p. 300–315, pl. 13.

Pospelow, W. Zur Lebensweise der Hessenfliege (*Cecidomyia destructor* Say). Illustr. Zeitschr. f. Entom., vol. 3, 1898, p. 100–102.

Stedman, J. M. Hessian Fly in Missouri. Mo. A. E. S. Bull 62, 1903, p. 131–149, figs. 1–6.

Thorne, C. E. The Hessian Fly in Ohio. Ohio A. E. S. Bull. 136, 1902, p. 1–24, maps, Nos. 1–3, figs. 5–11 and I–IV.

Washburn, F. L. The Hessian Fly. Minn. A. E. S. Bull. 77, 1902, p. 1–7, figs. 1–5, fig. 57; Bull. 84, 1903, p. 1–11, figs. 1–6; Bull. 88, 1904, p. 13–14; Bull. 93, 1905, p. 60–64, figs. 46–50.

——— Hessian Fly reared in the Laboratory. Canad. Entom., vol. 35, 1903, p. 316.

Webster, F. M. The Early History of the Hessian Fly in America. Proc. Soc. Prom. Agric. Sci. (Philadelphia.), vol. 26, 1905, p. 110–117. (Exp. Sta. Record 16, p. 622.)

——— The Hessian Fly. U. S. Dept. Agric. Bur. Ent., Circ. 70, 1906, p. 1–16, figs. 1–16.

——— Farm Practice in the Control of Field-Crop Insects. Yearbook U. S. Dept. Agric. for 1905; Hessian Fly, p. 474–475, pls. 54–55.

——— The Value of Parasites in Cereal and Forage Crop Production. U. S. Dept. Agric. Bur. Ent. Bull. 67, 1907, Hessian Fly, p. 95.

Worsham, E. L., and **Lewis, A. C.** The Hessian Fly in Georgia. Ga. A. E. S. Circ. 7, 1908, p. 1–8, figs. 1–6.

Bd Agric. and Fisheries (London) Leaflet No. 125, 1904, p. 1–3, fig. 1.

WESTERN SPREAD OF THE COLORADO POTATO BEETLE

(*Leptinotarsa decemlineata*)

By J. M. Aldrich, *Moscow, Idaho*

Economic entomology has preserved in its archives pretty full details of the eastward advance of this insect. Starting from the arid region along the east side of the Rocky Mountains in the late fifties, when the introduction of the potato first enabled it to "switch" from its wild food-plant, *Solanum rostratum*, it was about fifteen years in reaching the Atlantic seacoast of the United States, and in a few years more it was omnipresent in the eastern two thirds of the country.

It is a striking fact that the advance of settlement and potato-raising west of the continental divide did not carry the beetle with it. Professor Gillette writes me lately that even yet he has looked for the insect in vain west of the main divide in Colorado. As far as I have ascertained in considerable travel through the West, there are no potato beetles on the western side of the Rockies except as noted herein.

Professor Cooley of the Montana Experiment Station writes me that it has in quite recent years established itself in the Bitter Root Valley of western Montana, although as yet it has not reached the upper end of the valley. He also finds it in Flathead County. Both of these localities are on the western side of the continental divide.

A new western record for the insect is the town of Nez Perce, Idaho, about forty miles southeast of Lewiston. It has been established in that neighborhood at least two years, and seems to have spread considerably last summer. I do not know of it elsewhere in Idaho.

Considering the numberless opportunities for the carriage of adults westward on railroads, it seems probable that the species has generally died out when introduced, before it became fairly established. I am informed on very good authority that a potato patch in Moscow, Idaho, was infested about sixteen years ago, but the insect did not reappear the following season. Our wet winters may account for its inability to maintain itself here, but that certainly will not hold good in all the territory concerned.

It would be interesting to learn what others have observed in the West, both in regard to the spread of the insect and to the agencies which appear to retard its advance.

A MOTH LARVA PREDATORY UPON THE EGGS OF THE BAGWORM[1]

By A. B. Gahan

In the course of some rearing experiments of the parasites of the common bagworm, *Thyridopteryx ephemeræformis*, during the past fall and winter, the writer was surprised on numerous occasions to find in the cages specimens of a small pyralid moth. The repeated occurrence of this handsome little lepidopteron led to an investigation to ascertain the reason for its presence. The result was the interesting discovery that the moths, which were identified by Dr. H. G. Dyar as *Dicymolomia julianis* Walk., were feeding in the larval stage upon the eggs of the bagworm. Numerous bags collected in February from cedar and black locust were cut open and in a large percentage of them larvæ in varying stages of development were found buried among the eggs in the old pupal skins of the females. In one instance two larvæ were found in the same bag. In every case where a full grown larva was found, the eggs of the bagworm had been completely destroyed. A larva was placed in a small vial with some of the eggs and later observed to seize an egg in its mandibles and devour its contents. When full-grown the larva crawls out of the egg case, and proceeds to spin a small cocoon at the tip or free end of the bag within which it changes to a pupa five-sixteenths of an inch in length and of a clear pale red color. The imago after escaping from the pupal skin forces its way out of the bag at the lower end. Its normal time of issuance can at present be only conjectured, as specimens were obtained in the laboratory in each of the months of January, February, March and April. Under outdoor conditions, they would probably have appeared in late April or early May.

That this predatory moth constitutes a considerable check on the bagworm in this locality cannot be doubted when it is known that in some cases 25 to 30 per cent of the female bags were infested; and that its presence in the bags was not a purely accidental or local occurrence, but is a more or less well developed habit if not characteristic is proven by the fact that Prof. A. L. Quaintance reared it from the same source in Washington, D. C., coincidentally with the writer (as was brought out in a discussion before the Entomological Society of Washington in March, 1909).

Dr. Dyar informed us that the normal habit of the species as here-

[1]Contribution from the Entomological Laboratory of the Maryland Agricultural Experiment Station.

tofore understood was to live as a scavenger in the heads of the common Typha or cat-tail. The issuance as imagos as early in the spring as April or May precludes the possibility of the larvæ of this generation feeding on the eggs of the bagworm, and clearly indicates that there must be another host to carry it through the summer. That the larvæ at this time are in some way associated with the Typha head is likely, but whether they are there as scavengers or preying upon some other insect whose habitat is the Typha head is not apparent.

In connection with the rearing of this moth it is interesting to note that a small chalcid, *Leucodesmia typica* How., which is recorded by Dr. Howard as a parasite of a small moth, *Dakruma coccidivora* Com., predaceous upon our larger scale insects (Insect Life, VII, p. 402), was also reared from the bags of the bagworm and is in all probability a parasite of *Dicymolomia julianis.*

EGGS AND STAGES OF THE LESSER APPLE WORM

(*Enarmonia prunivora* Walsh)

By Estes P. Taylor, *Entomologist, Mo. State Fruit Experiment Station, Mountain Grove, Mo.*

During the summer of 1908 the writer had an opportunity of observing the eggs of *Enarmonia prunivora* Walsh, which had not been previously known to entomologists. This insect, as was shown by Mr. Quaintance in a paper upon "The Lesser Apple Worm" read before the Association of Economic Entomologists at Chicago in 1907 and published as Bulletin 68, Part V, from the Bureau of Entomology, has been found frequently infesting the fruit of the apple and in many cases its work has been mistaken for the damage done by the codling moth. I find this condition to prevail in the orchards of Missouri.

In the paper cited the difference between the two species was plainly pointed out, so that there should be very little confusion in distinguishing the smaller fusiform flesh-colored larva of the lesser apple worm, with its brownish caudal comb-like structure, from the larva of the codling moth. The work of the former was also shown to be different in several respects from that of the codling moth and of course there could be no mistaking the two when the adult moths were compared. Neither Walsh in Illinois, who first studied the insect in this country in 1867 as the "plum-moth," nor Riley, who studied the insect in Missouri in 1869, mention ever having seen the egg. Fletcher,

Lugger, Webster, Newell, Simpson and Chittenden are also the authors of literature upon this species, but none make mention of having observed the eggs and in the more recent paper by Mr. Quaintance it is stated that the egg had not been observed.

The writer on June 19, 1908, at Olden, Mo., collected from the smooth surface of small apples and from the upper surface of apple leaves borne near fruit, eggs which were at the time taken to be those of the codling moth. At the time of collection some of these specimens were noted to be much smaller than others in the lot. Some of these smaller ones were placed in breeding cages at approximately out-door temperature. A number of the larvæ hatched and entered apples placed in position for them. Upon the emergence of the larvæ from the fruit several specimens resembling the larvæ of *Enarmonia prunivora* were isolated and in time yielded adults of this species. To verify the determination of the moths reared, specimens were recently submitted to Mr. August Busck of the Bureau of Entomology, who has, through the kindness of Doctor Howard, looked them over and found them to be this species.

The eggs upon apple trees, so far as I have observed, are deposited singly either upon the smooth surface of the forming apple or upon the upper or glabrous surface of the apple leaves. In this respect the oviposition habits of the moth upon apple is not unlike that of the codling moth.

The eggs when freshly laid appear as small semi-transparent yellowish-white spots, looking not unlike much flattened and very small drops of milk. In outline they are usually oval, fitting closely down upon the surface as convex disks. Specimens measured upon an average .68 mm. long by .53 mm. broad, which measurements show it to be a trifle more than one half the size of the egg of the codling moth. They show a similar reticulation of the surface. During incubation they seem to undergo practically the same changes in appearance as seen in the incubation of codling moth eggs. The egg, at first milky white, shows, after a few days, a pinkish ring, which is the outline of the embryonic larva within. A day or two before hatching the darker anterior and posterior ends of the larva show through the egg shell as a dark spot. The hatching period is probably about five or six days under average orchard conditions, but no eggs were seen when deposited, though they were found when still fresh and milky and from this stage hatched in four days.

Larvæ under observation spent upon an average of 17 days in the fruit from the time they were seen to hatch until they emerged for pupation. From 21 to 23 days elapsed from the time eggs hatched to

the emergence of the pink fusiform larvæ from the apple for coccoon spinning, and in one instance gave 24 days from the time the larva left the apple to the appearance of the adult moth, with an average actual pupal period of 12 to 16 days.

The total life cycle of the lesser apple worm was found to be approximately the same as for the codling moth. Eggs of the lesser apple worm obtained in the orchard on June 19 hatched June 22–23. These yielded an adult moth August 7–8, or a period of 45 to 47 days from egg hatching to adult, which, with the addition of the time spent in the egg, places the total life cycle from egg laid to adult moth at approximately 7 weeks.

Apples were collected in the orchard on June 10 and placed in cages, which yielded an adult between July 11 and July 13, so it is quite probable that eggs of *Enarmonia prunivora* were already being laid in the orchard late in May, at which time apples of standard winter varieties measured from 1 to 1½ inches in diameter. At this date eggs of the first generation codling moth were numerous. Since many of these first generation lesser apple worms do not enter at the calyx, but at the stem or side, an arsenical spray seems to be necessary when the apples reach the size indicated. As applications at about this time are also necessary against the curculio and the larvæ of the codling moth, which enter the apple at other places than the calyx, special sprays against the lesser apple worm other than those aimed at curculio and codling moth do not seem at this time necessary in Missouri. The eggs of *Enarmonia prunivora* are, according to the writer's observation, laid a few days later than those of the codling moth, and this fact, in cases of great abundance of the lesser apple worm, would somewhat emphasize the importance of a spray at this particular time.

ARSENICAL POISONING OF FRUIT TREES

By Wm. P. Headden

There appeared in the April number of this journal an article by Dr. E. D. Ball under the title "Is Arsenical Poisoning Killing Our Fruit Trees?" An address on this subject by Dr. Ball appeared in the *Desert Farmer* of February 27, of which the present paper is an abstract. Subsequent to the publication of the address Doctor Ball wrote to me disclaiming the personalities in the article in the following language: "This article is intended to be in no way personally controversial" . . . and in closing he adds, "Trusting that you will

interpret my motives, as I interpreted yours, that is, as an impersonal attempt to present the truth as you see it," etc.

I was glad to receive this wholly voluntary statement from Doctor Ball, for the impression made by the original article and this abstract of it is unfortunately both personal and controversial. The reader of either article will certainly infer from its general tenor as well as its language that my judgment in this matter is not entitled to serious consideration, to quote his own words, "Doctor Headden is not, however, a horticulturist or a plant pathologist . . . and his conclusion . . . is open to serious question." This in fact seems to be the weightiest argument produced why the conclusions of Bulletin 131 of this station should be seriously called in question.

Next to the preceding in importance is the allegation that I have based my conclusions on insufficient facts. He says, "It might also be well to state that the conclusions of the Colorado bulletin are apparently based upon few observations in the field, the greater amount of work having been done in the laboratory hundreds of miles from the spot where the damage occurred." Further in his conclusions he states, "That the entire subject of arsenical poisoning is a matter for careful and exhaustive investigation and any statements preceding that investigation should be of the most guarded nature."

Such statements are certainly unfortunate if the article is not personal, and is not controversial.

I am not quite clear as to what Doctor Ball's object is in these articles. I cannot find in either of them that he has made any investigation of the facts presented in Bulletin 131 of this station. He seems to be willing to accept my chemical findings but wishes to deny my conclusions without good reasons. He seems to be motived principally by a desire to defend the use of arsenical sprays by asserting that arsenic cannot be the cause of the death of certain trees, which he thinks were killed by something else. This is certainly not reasonable, for I have not attacked the practice of spraying but have simply pointed out certain injuries which it has already produced and given warning of the serious dangers attending the application of arsenicals to our trees, especially in the excessive amounts heretofore used. Doctor Ball seems to object to my doing these things without any further reason than that he seems to think that it is a naughty thing for me to do, and accordingly delivers himself as follows: "If, on the other hand, he is mistaken in his conclusions, the publication is most unfortunate, as it will no doubt cause a decided reaction against a now highly successful method of spraying and bring consequent financial loss to the fruit industry."

I took this and much more into consideration before I wrote Bulletin 131, but the conclusions at which I had arrived seemed to me to be far-reaching enough to justify their publication, whatever the immediate results might be. I was fully aware that many orchardists might offer opposition to further spraying, especially if they have been slow in recognizing the benefits of the practice. For such reasons I was more than ordinarily careful about my facts and was not hasty in my conclusions, nor did I permit myself to draw conclusions which are broader in their scope than the facts on which they are based justify, as is intimated throughout Doctor Ball's articles. The only statements which I can find in his articles that in any way tend to invalidate any statement made by me are those pertaining to my incompetency to determine the facts.

Doctor Ball does not attempt to show that the trees that I described were not killed by arsenic, but alleges that alkaline ground waters are killing trees in Utah, and concludes that the trees described by me were also drowned or killed by alkali. That trees may be drowned is a generally known fact. What the action of our alkali may be on ten or fourteen-year-old trees is an open question not so easily disposed of as one might imagine from Doctor Ball's statements. This question, so far as the statements of Bulletin 131 are concerned, is easily disposed of, for at least five of the orchards from which trees were taken are on mesas, where seepage is impossible, and none of the trees were taken from seeped lands.

Doctor Ball's comparison of the conditions in Utah and in the lower and heavier lands between Fruita and Palisade is not just because it leads the reader to conclude that the trees described came from such lands, which is not true. Indeed, some of the orchards referred to in Bulletin 131 have never had what may be called an abundant supply of water. One of the pear orchards described is above the highest ditch in that section, a wheel being used to raise the water for irrigating the orchard. Doctor Ball is acquainted with some of these orchards, which for obvious reasons I cannot specify, but he does not seem to have considered the conditions obtaining in them. Again, while it is true that there is some seeped ground between Fruita and Palisade and that some trees have been drowned, which fact I observed at least fourteen years ago, I described no tree in Bulletin 131 which I knew or believed to have been drowned. Besides, this country is in no such bad condition as the doctor's statements would lead one to infer. I have seen trees in this section which were dying, the main lateral roots were dead, the crown was girdled beneath the the ground and the roots showed the presence of much arsenic. The

soil is a sandy loam and the water plane at the shallowest point is eight feet below the surface. I have met with cases of arsenical poisoning as described in Bulletin 131 at points where the water was 75 feet below the surface on a mesa 150 feet above the river bottom. All of the doctor's statements may be entirely true for what he has seen in Utah but have no application to the facts set forth in the bulletin which he attempts to discuss.

Another point which he makes is that the readers of my bulletin are left to infer that arsenic is the only cause of death among our orchard trees. At the bottom of page 6, Bulletin 131, I make this statement, "I have already clearly indicated my conviction that the cause of the trouble is arsenical poisoning. That there are some trees suffering from other causes is quite certain, but the cause of the greater portion of the trouble is the arsenic which has accumulated in the soil." I marked this passage and sent him the bulletin and yet he says, "In fact nowhere in the bulletin can we find a statement that would lead us to believe that he knows of any cause of trees dying where no arsenical sprays have been used." I did not attempt to describe all sick or dead trees but only some for whose condition our station had been unable to find any cause known at that time.

Doctor Ball further states: "He (Headden) then examined the soil under the trees that had been sprayed and found arsenic present in considerable quantities, but in an insoluble form." The inference to be drawn from this statement is clearly that there is no soluble arsenic in the soil. This is wholly wrong, and if the doctor does not know it, he has utterly failed to get one of the most important points in the bulletin. On the first page of Bulletin 131 I state, "The protection against arsenical poisoning in the case of our orchard trees is the insolubility of the arsenical preparations used in spraying, and, further, that these preparations shall not be changed or become soluble in the soil." Again on page 8, "We find in fact what was from the beginning patent, namely that the arsenic does accumulate in the soil and is already present in our orchards in dangerous quantities, if it by any means should become soluble." On page 22 I state: "We have then direct proof that the alkali salts in the soil are capable of bringing the arsenic, even when present as lead arsenate, into solution and consequently making it a source of danger." Again in the summary I state: "The insoluble arsenical compounds are being converted into soluble ones in the soil."

Doctor Ball suggests that the Grand River water may be the source of the arsenic in the trees. He says: "This may possibly be the source of some of the arsenic found by Doctor Headden rather than

from the insoluble compounds used in spraying." One would infer from this statement, in fact in the original article he states, that "the entire district investigated by Doctor Headden is watered by irrigation canals taken from this stream . . ." This is not correct. A large part of the district investigated is not irrigated by Grand River water. I have made several complete analyses of the Grand River water and have never detected the presence of arsenic in it. As a fact there is no smelter, very little milling, if any, and only a very little mining carried on, either on the Grand River or its tributaries, above Grand Junction. But if the facts were in favor of his assumption this would not apply to those cases where the water comes from other sources, for instance from mountains where there are no known ore bodies and where the melting snows furnish the water, which flows but a short distance through a section where there are no mines, no mills of any kind, but simply volcanic and sedimentary rocks covered with forests of aspens and cedars. This suggestion is wholly gratuitous and without a shadow of foundation.

Doctor Ball diagnoses the affection of our trees and concludes that they are dying from a disease which he designates as "collar rot." Doctor Ball states that I am not a horticulturist nor a plant pathologist, but he evidently assumes to be both and to express an expert and final judgment without knowing very much, if anything, about the facts in the case.

There is no resemblance between our corroded crowns and the King disease, known as collar rot. Neither Mr. Whipple nor Professor Paddock, who are by profession horticulturists and plant pathologists, have been able to recognize this trouble as similar to any known disease, though they have had it under observation for five or six years, but Doctor Ball, who, so far as I know, has never seen a case of this affection except in the collection of samples which I gathered and used as the basis of Bulletin 131, passes judgment with a confidence which is refreshing. That he intends to assert the identity of the Utah and Colorado conditions is evident from his conclusion announced in the following words: "The only conclusion that it seems possible to draw from the facts cited is that arsenical poisoning cannot be the primary cause of either one of the above described conditions, and that therefore the main conclusion of Colorado Bulletin No. 131 is unwarranted."

Doctor Ball in describing the conditions on which the above conclusion is based cites three orchards with which he is familiar, especially one belonging to Lars Nording of Hyrum, Utah. If this case shows anything, it shows that the Jonathan is immune from the attack

of the disease which caused the death of the Ben Davis, his collar rot. He says: "As fast as a tree (Ben Davis) died, Mr. Nording replaced it with a Jonathan in the same hole and so far has not lost a single Jonathan." The same statement is made on page 146 of the JOURNAL, but the language is not so explicit. I state on page 6, Bulletin 131: "The varieties affected in this way are by no means confined to the Ben Davis and Gano. The following varieties are also affected: Spitzenberg, Early Harvest, Wolf River, Lawyer, Blacktwig, Baldwin, Jonathan, Grimes Golden and Pewaukee, and without doubt other varieties might be added if search were made to find every variety affected in this way. The trouble also extends to pear trees, but I have studied apple trees mostly." It is plain that I do not confine the trouble to the Ben Davis, and the fact is that we have more sick Jonathans than of any other single variety, and the most pronounced instances of corroded crowns, dead roots and darkened tissue are found in this variety.

To point out the effects of the admissions which Doctor Ball is kind enough to make in recognition of some points of value in the bulletin or to point out further how he has failed to see the force of the facts adduced (for instance, the relation between the presence of soluble arsenical compounds in the soil and the effect of the soluble sodic arsenite emptied into the ditch twelve feet from the tree) would make this answer too long, but there are still some things which I am justified in pointing out and that without the least personal feeling in the matter. The whole tenor of the article lacks frankness and in some respects is misleading,—for instance, that I spent too little time in the field to justify me in entertaining an opinion. This is a point on which he has no information.

The fact is that this difficulty with the trees had been under observation for four or five years by Mr. Whipple and Professor Paddock, the latter of whom, in particular, had repeatedly talked with me regarding the matter, as he knew my views in regard to the probability of danger from arsenical poisoning, and it was more than a year before the publication of Bulletin 131 that I began the actual field work.

Doctor Ball in the original article refers to a careful investigation that he made since the publication of Bulletin 131. This bulletin appeared in July, was distributed not earlier than August, and Doctor Ball had scarcely had the time to make a careful investigation. I have his own statement for it that this article was written in advance of careful experimental work. I am sure that it was not his intention to mislead anyone but that his zeal for the cause of arsenical spraying led him into making this unfortunate statement, unfortunate

not only because it is misleading, but because it is in strong contrast with his own statement, intended to apply to others as well as to myself, when he says: "The entire matter is one that calls for careful and exhaustive investigation and for cautious and guarded statements of any kind until the results of these investigations are known. Hasty and ill-advised statements with reference to the purity of arsenicals have already done a great injury to the fruit industry in the inter-mountain region."

The conclusions which he draws are not justified by any facts adduced. The fact that trees are killed by alkali water in Utah is no proof that trees planted in well-drained ground in Colorado should not die of arsenical poisoning.

In his second conclusion he fails to recognize my statement regarding the solubility of the arsenic in the soil.

His third conclusion, relating to careful and exhaustive investigations, hasty and ill-advised statements, etc., is a reiteration of a remark which I have already quoted several times and is one which any one with an ordinary acquaintance with the civilities of life will interpret as being very severe and as indicating that Doctor Ball exercised himself to say something real authoritative.

In conclusion I repeat: "I regret that I can see no other conclusion than that the corroding of the crowns, the killing of the bark, the staining and final destruction of the woody fiber, the early ripening of the leaves, presaging the early death of the tree and its final death a few months later, are caused by arsenical poisoning."

I shall in the course of a few months present another bulletin on this subject, which will show that Bulletin 131 is over-conservative on every point touching the action of arsenic, especially in regard to the systemic poisoning of our orchards. I can scarcely hope to be able to distinguish clearly between the action of lime and arsenic and the part that each may play. This statement is based on results already obtained, which I sincerely wish were other than they are, but they are so positive and serious that I venture to state that we must either find some other still more insoluble arsenical compound than any which has heretofore been used or find some other substance with which to combat the codling moth, or eventually render our trees so short-lived as to curtail the profits of orcharding.

NURSERY INSPECTION IN MINNESOTA

By F. L. Washburn, *St. Anthony Park, Minn.*

I am very glad to comply with a request of the editor and start the ball rolling in the direction of a series of articles from different nursery inspectors, showing how the work is carried on in various states.

Minnesota, of course, does not have the problems to combat present in many other states, which are partly or entirely in zones more conducive to the presence of insect pests on fruit and nursery stock. At the same time it is forging ahead as a fruit-growing state, the acreage is increasing yearly, and we have something like a hundred nurseries, many of which are doing a good business, and some of which have a very large patronage.

The nursery inspection law of Minnesota forbids the entrance into the state of any stock not properly certified. It does not oblige every nurseryman within the state to have his stock inspected, although it gives the entomologist of the experiment station power to inspect any stock on which he has reason to suspect the presence of an injurious insect or plant disease. Out of the approximately one hundred nurseries above referred to, inspection is asked for about sixty-five. This work is done either by the entomologist himself, or by his chief assistant, the latter last year doing a very large portion of the work in question. The law requires the nurserymen to bear the expense, and also to pay a fee to the inspector at the rate of $5 a day for the time occupied. This fee is turned in to the state at the end of the season. The work is simplified and the expense to the nurserymen lessened by grouping the nurseries, as far as possible, on circuits, each nurseryman on a circuit bearing his portion of the expense of inspection on that circuit.

A curious condition arises in connection with this work, no doubt met with commonly by other inspectors, from the fact that the law gives us no discrimination as regards what constitutes a nursery. A man may have only two or three hundred trees on a small piece of ground, which he simply rents, and the inspector may be reasonably satisfied that the nurseryman is not doing business on an honorable basis, and yet if he finds this man's trees free from pests, plant or animal, he has to give him a certificate, which can be used, of course, on any trees obtained from any source. We, however, protect ourselves in this particular by stating on the certificate that the same only applies to stock absolutely on the premises when examined.

As brought out in discussions at various times among inspectors, no

one can absolutely declare that the San José scale does not exist somewhere in a nursery. Should the Minnesota inspector or his deputy attempt to examine every nursery tree in some of our larger orchards or nurseries, it would mean anywhere from a three to six weeks' sojourn in one nursery. We probably pursue approximately the same plan adopted by other states: a block of trees is traversed in two or three directions, and the trees looked over first in a general way, and afterwards more in detail. If, however, any one tree, or more trees, attract attention on account of some peculiarity of appearance, those trees are given most careful scrutiny. So far we have never discovered in Minnesota any San José scale, although it has been present three years in Wisconsin, and we have known of its surviving two winters in South Dakota, and experimentally we have carried it through one winter in Minnesota, exposed to weather conditions. It is rather a surprising fact that with all the importation into this state during the past twelve years or more, we have not, in the six years of inspection, yet met this scale here. We fully expect to run across it before long, and the inspection for that and other reasons is becoming more rigid every year. The presence of San José scale, of course, disqualifies, as does also Crown Gall and Wooly Aphis.

Our inspection season lasts from May 1st to September 15th. Minnesota nurserymen are almost without exception on the most friendly terms with the inspector, and many happy hours have been spent in their company and at their hospitable homes. It must be said, however, that a great many of them look upon inspection as a humbug, in a mild way, a necessary nuisance, as it were, which has to be endured on account of the laws of other states into which they ship, but I think that within the past year, since the danger in importing foreign stock has presented itself, the sentiment in favor of careful inspection is growing. In this connection it may be said that we have been very much surprised at the amount of stock coming from Europe into Minnesota. When the alarm was first sounded this spring we sent letters to nurserymen, asking for information regarding any expected shipments, and were very much surprised to hear from one large nursery that a shipment from France was expected, and later on, work in this connection having been established with Dr. Howard and with the State of New York, we have been enabled to be advised of, and to examine, a large amount of this stock both from Holland and France, something less than a hundred boxes all told, up to the date of writing. We have found absolutely nothing in these shipments in the shape of the Brown-tail Moth caterpillars, Gypsy Moth eggs, or any other pest.

NURSERY AND ORCHARD INSPECTION IN MARYLAND

By T. B. Symons, *State Entomologist, Md.*

The introduction into Maryland in 1894 of the San José scale and its gradual spread during the last decade, threatening the fruit interests of the state, caused the passage of a law by the Maryland legislature in 1896 and additional amendments to said law in 1898, establishing the State Horticultural Department and creating the offices of State Entomologist, State Pathologist and State Horticulturist, and making these officers Professors of Entomology, Pathology and Horticulture respectively at the Agricultural College and Experiment Station. The purpose of the law as set forth was to suppress and eradicate the San José scale, peach yellows, pear blight, and other dangerously injurious insect pests and plant diseases throughout the State of Maryland. The enforcement of the law was placed under the control of the Board of Trustees of the Maryland Agricultural College and Experiment Station, to whom the officers created under the act are responsible.

The law specifically sets forth the duties of the State Entomologist and State Pathologist in conducting their work for injurious insects and plant diseases. It orders the inspection of all nurseries in the state at least twice a year by said officers, and directs that the officers visit each county in the state at least once a year for the purpose of determining by inspection the healthfulness and general condition of the horticultural and agricultural interests. Full power is given these officers to enter upon any public premises and to cause effective treatment of any plants and trees that may be found infested by an injurious pest, prescribing the method of procedure in conducting such inspections. The law prescribes that no trees, plants, vines, shrubs of any character can be sold within or without the state unless accompanied by a certificate of nursery inspection. It further precludes the introduction of any nursery stock from any other state or territory without the acceptance by the above officers of the certificate on such shipments. Eight thousand dollars has been the annual appropriation to the State Entomologist and State Pathologist for the conduct of this inspection work. It is only necessary for the purposes of this article to state the conditions under which this work is carried on in the State of Maryland at this time.

Nursery Inspection

There are at present fifty-two nurseries in the state from which plants and trees of various descriptions are being sold annually. While this is a rather small number of nurseries, yet there are included some of the largest nursery firms in the country. The output from the nurseries of Maryland aggregates approximately 35,000,000 trees and plants annually. As prescribed by law, the inspection of the nurseries is conducted conjointly by the State Entomologist, State Pathologist and their respective assistants.

The law prescribes two inspections annually, but it is only to the principal one of these that I will refer in these remarks, namely, the inspection of the nurseries conducted in late summer and early fall. This inspection is not commenced until after August 20th, as in our opinion a certificate issued on an inspection made before this date in this latitude would be of little value, since in the case of San José scale, for instance, there would yet be time for two or three broods of the insect and consequent dissemination of the pest before the cold weather of fall. The inspection therefore is conducted as late as possible in order to be completed in time for fall trade. It can be stated that the inspection in this state is conducted as thoroughly as circumstances and funds will permit. It is obviously impossible for the inspectors to examine every salable tree in a nursery, especially in nurseries of the size indicated above. It only remains for the inspectors to go through the blocks as thoroughly as possible, satisfying themselves as to the condition of the trees. We usually arrange to go through the blocks in a direction at right angles to the rows with an average distance of twenty to thirty feet between inspectors. Thus examining trees closely from the ground up in each row at this distance apart, the inspectors will invariably detect the presence of any injurious pest. In our experience we have not as yet had develop later a single case of infestation by an injurious pest which we had not located during the inspection.

Upon detecting the presence in a block of trees of any injurious pest likely to be dessiminated, we at once closely inspect surrounding stock and blocks. The trees found infested are immediately destroyed and no trees are allowed to be sold from blocks in which infested trees were found until after a hand inspection of all trees is made. As a further precaution, all trees sold from the nurseries in Maryland are required to be carefully fumigated with hydrocyanic acid gas. Thus we believe that the inspection of nurseries in this state is conducted on as high a plane as is practicable and that such inspection affords

as much protection to the orchardists and other growers, as well as to the nurserymen themselves, as is practical in the operation of such a law.

The State Entomologist and State Pathologist make it a point to do the inspecting of nurseries personally with the help of their regular assistants and the forces are divided only in the case of the very small tree nurseries or those that raise simply strawberries or like plants. Thus we aim to learn the exact conditions ourselves and follow up any prescribed treatment after such inspection. No certificate is granted to a nurseryman until after he has signed a written contract to the effect that he will not sell any trees that may be badly affected by wooly aphis or crown gall; and if the San José scale should be detected, his contract includes a close hand inspection of the stock from such infested blocks. Thus we aim to give the orchardists as good a guaranty as possible under existing conditions, that the stock they receive from Maryland nurserymen can be considered as free from such pests as similar stock from the nurseries of any state in the East. It is only fair to state in this connection that the Maryland nurserymen readily comply with the requirements made by the officers charged with the enforcement of the law.

Additional inspections were necessary this past spring on account of the finding of Brown-tail moth nests upon imported stock. Over 1,125,000 seedlings and other nursery stock have been carefully inspected during the past three months in this state. In all about 700 nests of the Brown-tail moth have been destroyed.

Orchard Inspection

As mentioned above the Maryland horticultural law directs that the State Entomologist and State Pathologist or assistants visit each county in the state at least once a year for he purpose of determining by inspection the healthfulness and general condition of the horticultural and agricultural interests. For a time the officers of the department endeavored to visit as many parts of the state as possible, but this procedure, while being a great help, did not promote the work as was desired.

The employment of local inspectors to inspect orchards for San José scale and yellows was then undertaken. The inspectors were given a course at the Maryland Agricultural College to better fit them for the work. This scheme of orchard inspection was decidedly more satisfactory and continues to be the most effective plan of reaching all parts of a given territory. While it is possible to inspect only a part of the state each season, the work gradually covers the whole

state. The local inspectors have their allotted territory each year in their respective counties. They are thus enabled to visit each individual orchard and report its condition to the office of the department. They come in personal contact with the grower and can point out injury caused by any pest or disease and advise him as to treatment.

Furthermore, by this local inspection a better acquaintance with the conditions in each locality is acquired and we are enabled to give direct attention to direfully neglected cases and cause treatment either by showing to the owners the great necessity of the same or, if necessary, by enforcing the law.

Moreover, the local inspectors can explain the work of the department to the orchardists, and show them that our efforts are directed towards helping them in the protection of their trees and the production of good crops, rather than in seeing the law enforced. Twenty-seven local inspectors worked in Maryland last season.

Thus the inspection of nurseries and orchards is conducted in Maryland with little or no friction, and the horticulturists as a whole are ever ready to support the work of the department.

SOME HOST RELATIONS OF TICKS[1]

By W. A. Hooker, *Washington, D. C.*

In a paper presented at the meeting of the Association of Economic Entomologists last year, the host relations of ticks were briefly considered. At this time I propose to present some additional information and deductions that have been drawn. I wish to call your attention first to the fact that in Mr. Nathan Banks' "Revision of the Ixodoidea," which was issued in June, we now have a work by means of which the ticks of this country can be readily identified. In this work nine genera, thirty-eight species (one doubtful) and one variety are described from the United States, including Alaska. During the past year three undescribed species, one an Aponomma (a genus hitherto not known to occur in this country) and *Amblyomma dissimile* (a Mexican and Central American species) have been collected within our borders, thus bringing the total up to at least ten genera represented by forty-one species and one variety. Incidentally it should be mentioned that collections of this one variety (*Dermacentor par-*

[1]Presented at the Third Annual Meeting of the Entomological Society of America, held at Baltimore, Md., December 30 and 31, 1908.

unipertus var. *marginatus* Banks) from jack rabbits and cotton-tails, upon which it is commonly found in southwestern Texas, leads us to infer, from characteristic color markings, that it may be a valid species.[2] This then is a greater number of species than we find listed by Mr. C. W. Howard in his recent work on the South African ticks.[3]

Of the fourteen species and one variety occurring in this country whose life histories we have now nearly completely worked out, three species molt upon the host, the Cattle Tick and Tropical Horse Tick (*Dermacentor nitens*) passing both molts and the Spinose Ear Tick (*Ornithodoros megnini*) the first molt before dropping.

Early in the fall of 1907 the writer, accompanied by Mr. J. D. Mitchell, found after a careful examination of quail (*Colinus virginianus*), at Brownsville, Texas, a number of larvæ and nymphs upon the dorsum of the head. These were recognized at once as belonging to the genus Hæmaphysalis. From the fact that *H. chordeilis* was the only representative of the genus found in this country that had been reported as attaching to birds, it was thought that these ticks belonged to that species. In collections made later at D'Hannis, Texas, several larval skins were found attached to the heads of quail and field larks (*Sturnella magna neglecta*) in connection with larvæ and nymphs. The finding of these skins with the immature stages naturally leads us to conclude that they were shed by the species of tick with which they were found. The possibility of their having been shed by a little known species (such as the Aponomma recently discovered) must, however, be considered. An adult that developed from an engorged nymph collected at D'Hannis has been identified by Mr. Banks as *H. chordeilis*. Further collections made in Victoria County, Texas, by Mr. J. D. Mitchell and at Grand Cane, Louisiana, Quincy and Hawthorne, Florida, by the writer, have shown that in the fall of the year at least nearly all ground-feeding birds serve as hosts for the larval and nymphal stages of this tick. In the collection of these ticks the writer has accompanied several old hunters, none of whom had ever observed them upon that generally distributed game bird, the quail, and questioned the veracity of a statement to that effect until they were shown. That these ticks have not been collected from game birds may be explained, however, by their small size and the fact that a large percentage leave the host even before the blood coagulates. The percentage of infestation of quail is shown to be large from the

[2]Since this paper was prepared Mr. Banks has examined recent collections and informs me that he now considers this tick to be a distinct species.

[3]Twelve genera, thirty-three species and six varieties are listed.

following report, made by Mr. J. D. Mitchell, of collections in Victoria County, Texas, in December, 1907: "On December 19 I shot twelve quail, each of which, as soon as killed, was placed in a clean white sack. The first examination was made thirty minutes after death, when sixty-five ticks were found in the sack. The other eleven birds were apparently equally infested. Upon removing the birds from the sacks more than five hundred ticks were collected. That there were 1,000 ticks upon the twelve quail would be a conservative estimate." In a collection of ticks received by the Bureau of Entomology from Prof. F. L. Washburn was found a Hæmaphysalis nymph labeled as taken from a Harris sparrow (*Zonotrichia querula*) at St. Anthony Park, Minnesota. Thus it is seen that this tick is nourished and disseminated in great numbers by these hosts in a large part of the United States. Unfortunately we are unable to distinguish *leporis-palustris* from *chordeilis* in the immature stages. As an adult specimen of *chordeilis* has also been collected in Victoria County, Texas, from a quail, we feel justified in concluding that at least a portion of these immature ticks belong to that species. While, with the exception of an engorged female reported as taken from a horse in Texas by Dr. Cooper Curtice, *H. leporis-palustris* has never been reported as taken from hosts other than hares and rabbits, it is not too much to suppose that the immature stages of this tick, so common on these hosts, also attach to birds.

During the past year two adults of a new species of Aponomma[4] have been collected by Mr. J. D. Mitchell, one an engorged female from a dog at Corpus Christi, Texas, the other a partially engorged female from a rabbit at Refugio, Texas. Several engorged nymphs and numerous unengorged larvæ of apparently this same species were collected by the writer in December, 1907, from quail at Hawthorne, Florida, thus showing that this species is widely distributed throughout the southern part of the United States.[5]

Larvæ and occasionally engorged nymphs of a species of Ixodes, probably either *Ixodes scapularis* or *cookei*, have been found by the writer attached to birds at Grand Cane, Louisiana, and Hawthorne, Florida, on blue jays (*Cyanocitta cristata*) and at Quincy, Florida,

[4] Since described by Mr. Nathan Banks as *A. inornata*.

[5] The fact that molted larval skins have been found on birds in Texas in connection with the immature stages of Hæmaphysalis and not on birds in Florida in connection with the immature stages of Aponomma surely is strong circumstantial evidence. This habit will soon be determined, however, either by the collection of perfect skins or from the breeding of seedticks that have hatched from eggs deposited by one of the type specimens.

upon an undetermined species of thrush. An engorged nymph was taken by Mr. J. D. Mitchell in Victoria County, Texas, from a quail. In Prof. F. L. Washburn's collection there is a male specimen of *Ixodes cookei* labeled as taken at St. Anthony Park, Minn., from a robin (*Merula migratoria*).

We have also found that birds serve as hosts for at least two American species of Amblyomma. *Amblyomma americanum* larvæ, unengorged and partially engorged, in large numbers, also a male specimen, were taken in Kerr County, Texas, from a chaparral cock (*Geococcyx californianus*) by Messrs. W. D. Hunter and F. C. Pratt in August, 1907. Thus we find a bird disseminating a species that is of economic importance. But little has been known of the life history and habits of *Amblyomma tuberculatum* except that it is found upon the gopher tortoise (*Testudo polyphemus*) in Florida. Recently Prof. H. A. Morgan has informed the writer that he has seen a specimen of this tick that was collected in southern Alabama. The writer has collected the engorged larvæ in large numbers from dogs and from a cotton-tail rabbit at Hawthorne, Florida, and larvæ that were collected from cattle at Sorrento, Florida, have been received from Mr. P. B. Powell. In January of the present year several specimens of engorged larvæ were collected from the head of a sparrow hawk (*Falco sparverius*) by Dr. E. A. Back of the Bureau of Entomology. During an examination of the Bureau of Entomology collection the past winter, the writer found three poorly preserved specimens of engorged larvæ taken from an owl in Florida, which are undoubtedly *A. tuberculatum*. The fact that they have only been found upon birds of prey suggests the idea that they crawled to the bird-host from the rabbit or other small mammal being devoured. In life history work nymphs of this species have been found to attach readily to and engorge upon a bovine. To summarize: The larvæ of *A. tuberculatum* have been taken attached to mammals and birds. The nymphs are commonly found on the gopher tortoise and have experimentally engorged upon a bovine, while the adults will apparently attach to cold-blooded animals only. We have found this species when engorged to surpass in size the African species *Amblyomma hebræum* and *Hyalomma ægyptium*, one gorged female having measured nearly an inch in length, actually measuring 24.0 mm. long by 18.5 mm. wide.

Thus we find birds acting as hosts and disseminators in this country of the immature stages of a number of species, representing the genera Amblyomma, Hæmaphysalis, Ixodes, and probably Aponomma. Habits of this nature may account for the wide distribution of *A. americanum*, *H. leporis-palustris* and other species, the migratory ter-

restral birds probably playing the more important rôle in their dissemination.

Amblyomma dissimile is a species found on iguanas in Central America and Mexico. During the past year it was collected at Brownsville, Texas, by Mr. H. P. Wood of the Bureau of Entomology from iguanas that had been brought from the isthmus of Tehuantepec for exhibition purposes. It is supposed that the host relations of this species are similar to those of *A. tuberculatum*, for nymphs as well as adults were collected from the iguanas. Larvæ and nymphs have attached to and engorged upon a bovine, but adults would attach to a cold-blooded host only.

Fortunate it is that birds do not play the rôle of host to the Cattle Tick, else our national campaign of extermination would be in vain. As far as we know, except in the case of *A. americanum*, these bird-host relations are not of economic importance in this country, at least at the present time. Should a tick-borne disease be introduced and one of these species become implicated, birds might be an important factor in its spread.

Aside from some of the larger mammals, the host relations of the Spotted Fever Tick (*Dermacentor venustus* Banks) still remain to be determined.[6] During the past year we have found all stages of this tick to engorge upon a bovine. While there are no records of birds serving as hosts for any species of Dermacentor, such a possibility, as well as that of reptiles and batrachians, must be considered. Suspicion is most naturally placed upon the small mammals as harborers of the spotted fever infection, since it seems most probable that they serve as hosts of this tick and play an important rôle in its dissemination. Dr. H. T. Ricketts in connection with his investigation of the disease and Prof. R. A. Cooley,[7] as the entomologist of the state in

[6]A report by Doctor Ricketts of investigations made during 1907 and 1908 into the cause and prevention of Rocky Mountain Spotted Fever in the Bitter Root Valley of Montana has recently appeared (February, 1909). In it Doctor Ricketts states that he has found by inoculation that the gopher, rock squirrel, wood chuck, chipmunk. and mountain rat are susceptible to the disease and also serve as hosts for the Spotted Fever tick. Experiments with the tick are said to indicate that at least the first four of these hosts may, when acting in conjunction with the tick, be effective in maintaining the disease by causing its extension among the ticks. The host or hosts of the infection in nature, however, has not as yet been discovered.

[7]In a report of his investigations of the Spotted Fever Tick in 1908, which appeared in April, Prof. R. A. Cooley includes data on its host relations. All of six Rocky Mountain Pikas (*Lagomys princeps*) and two of the twelve chipmunks (*Tamias quadrivittatus ameonus*) collected had immature ticks upon them. None were found upon any of twenty Red or Pine Squirrels (*Sciurus hudsonicus*) collected.

which the disease is most widespread, are now investigating the life history and habits of this tick and we may soon look for important developments. It is of course necessary that the host or hosts which harbor the infection in nature be discovered before it can be determined whether preventive measures will consist in dealing with the animal or animals that harbor the infection or with the tick that transmits it. In order to determine the source of this infection, it appears to be necessary that ticks, either sufficiently engorged to molt or to deposit eggs, be collected from their various host species and engorged in the following stage or stages upon a susceptible host, such as the guinea pig. When we consider that the mortality from the disease is as high as 70 per cent, the danger that is entailed in the investigation is at once appreciated.

The brilliant work of Dr. H. T. Ricketts in connecting the tick now known as *Dermacentor venustus* with the transmission of the disease has well been rewarded in the award of a gold medal by the American Medical Association at the annual meeting held in June.

Even field mice appear to play a rôle in the multiplication and dissemination of ticks. During the recent examination of the Bureau of Entomology collection an engorged larval specimen that appeared to be *Dermacentor variabilis* was found with a label to the effect that it had been collected from the nest of a field mouse near Washington, D. C. It will undoubtedly be found the world over that birds and small mammals serve as hosts for the immature stages of various Ixodid ticks. In a country like Africa, where numerous tick-borne diseases obtain, the importance of these habits will at once be appreciated. That more has not been learned concerning them is due in part, as before stated, to their small size and the fact that they readily escape notice in the thick fur and feathers or drop before an examination can be made. There is much that remains to be learned about these relations through a more extensive collection, and it is hoped that entomologists and other collectors may extend their activity in this direction.

In connection with life history studies, geographical and host lists are being prepared in connection with which this subject will be considered more extensively. Any collections, records or data on the subject will be gratefully received.

Since this paper was presented a work entitled "Interim Report on the Parasites of Grouse," by A. E. Shipley, has come to hand, which gives some important information concerning the host relations of the European Castorbean Tick (*Ixodes ricinus*) in England. On page 5

of this work Professor Shipley says: "The larvæ and the nymphs are common enough on birds, lizards, and small mammals—in fact, on animals which live among and brush through grass or heather. It is only in the nymph and larval state that we find these ticks on the grouse. On each of the infested birds the specimens were fixed on the chin or round the eyelids—in fact, in such positions as the grouse cannot reach with its beak. In parts of Ross-shire, especially in certain woods, these ticks swarm in enormous numbers, and the keepers assure us that they kill large numbers of young blackgame. Hence there is nothing remarkable in finding this species from time to time on the grouse, where its presence must be regarded as accidental. The larval stages emerge from the eggs and probably crawl on to the heather, and thence on to the grouse or other animals which come in contact with the vegetation. We have found both larvæ and nymphs among the feathers, but in small quantities and on rare occasions. We have never found it in the crop, and it can hardly play any part in infecting the bird with tape-worms. . . . This tick occurs most frequently during the spring and early summer, but disappears after the beginning of July."

Scientific Notes

Further observations on Contarinia. The writer last June (Journ. Econ. Ent. 1 : 225–227) summarized our knowledge respecting the economic status of this genus. In the following issue (p. 243) he recorded serious injuries to early Moore grapes in the Chautauqua region by a species then designated as *Cecidomyia johnsoni* Sling. This spring we fortunately succeeded in obtaining the adult and found it to be a Contarinia. Furthermore, an examination of foreign literature shows that a European grape pest, *Contarinia viticola* Rubs., a species which has caused considerable damage in European vineyards, may be the same as the earlier characterized American form. Should further investigation prove this to be true, we have in this species another introduced pest. There is no forecasting the future place of this species as an American insect of economic importance. Our knowledge of the genus is such as to justfy regarding this grape blossom midge with grave suspicion. It adds to the number of destructive species of Contarinia and further emphasizes the practical importance of the genus. Full descriptions of the two sexes, together with an account of the insect, will appear in the writer's report for 1908.

E. P. FELT.

Nodonota punticollis Say was very abundant and injurious on rose bushes this season (June 8) at Ardmore, Montgomery County, Pennsylvania. Some of the flowers have as many as fifteen of the beetles feeding in them and the roses are rapidly destroyed.

HENRY SKINNER, M

JOURNAL OF ECONOMIC ENTOMOLOGY

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The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints of contributions may be obtained at cost. Minor line figures will be reproduced without charge, but the engraving of larger illustrations must be borne by contributors or the electrotypes supplied. The receipt of all papers will be acknowledged.—EDS.

It is a pleasure to include in this number two articles on methods of nursery inspection. We trust that they will provoke discussion and lead to a full and frank consideration of the more important problems arising in this branch of applied entomology. The importation last winter of many shipments of nursery stock bearing winter nests of the brown-tail moth aroused the country to the importance of nursery inspection. Unfortunately the inspection officials of various states were limited by political boundaries and could go no farther than is possible through mutual coöperation. We believe everything was done that was feasable to locate shipments of infested stock and to destroy the pests. Nevertheless, the necessity of national inspection or quarantine regulations made itself apparent to everyone conversant with the situation. Exclusion is immensely cheaper and much more satisfactory than suppression after a pest has become well established. The annual cost of fighting the gipsy moth in the restricted New England areas infested by this pest now amounts to much more than would suffice to maintain a thoroughly adequate national quarantine. The gipsy moth is only one among many imported insects, some of which have become widely established throughout the country and annually cause enormous losses. Furthermore, no one can foresee the time when some other very destructive pest will become established in this country. Nursery inspection, if it is to survive, must justify itself by excluding injurious species, or at least by preventing their unrestricted dissemination throughout the country. We all admit the desirability of national quarantine. A bill providing for this was before Congress last winter and was defeated because certain features were objectionable to nurserymen. The entire proposition should be thoroughly canvassed and an effort made to work out a harmonious solution which will afford maximum protection with minimum annoyance and loss.

An extraordinary campaign against the typhoid or house-fly is now in progress. Magazines, weeklies and dailies are cheerfully giving much space to exposing the true character of the insect. Satire, denouncement and exhortation are all being employed. Municipalities here and there are adopting much needed sanitary regulations designed to reduce the numbers of this nefarious fly. The Merchants' Association of New York City and some other associations, as well as numerous individuals, are giving much time and effort to this most commendable work. The control of this insect is an entomological problem, since efficient repressive work must be based upon adequate knowledge of the habits of the fly and the way these may be taken advantage of to reduce the numbers of the pest in the most economical manner. The sanitarian and the medical man are both in position to give cogent reasons for the suppression of this long tolerated menace and nuisance. Special pains should be taken to encourage every good feature of the movement and at the same time care exercised to avoid everything which may appear like an overstatement of facts. This campaign, if it is to be successful, must be conducted along common sense lines and the necessity of attending closely to details emphasized most strongly. Otherwise there may be a disappointing reaction, which may result in a serious set-back to home sanitation, not to mention the continuance of needless suffering and loss of health and life.

Reviews

Ticks, a Monograph of the Ixodoidea, by G. H. F. Nuttall, C. Warburton, W. F. Cooper and L. E. Robinson. Cambridge Univ. Press, First Part (Argasidæ), 104 p., 114 figs., 3 pls.

This part of the work, which has just been issued, is far from our expectations. It is not a monograph in any sense of the word. The authors have not used the great collections of Doctor Neumann, of the Paris or Berlin museums, all of which are so easily accessible to them, and of the utmost importance to anyone studying the ticks of the world. Consequently a number of species known to Doctor Neumann are unknown to them, and of those that they have examined one is struck by the paucity of specimens. Under each species there is a full bibliography and iconography, a brief technical description (in many cases more or less compiled), and as much matter on the habitat and geographical range as can be obtained from the literature. There is an interesting chapter on the biology of the Argasidæ, almost wholly compiled, and an extensive bibliography. Most of the figures are taken from Neumann. The plates are original. N. Banks.

The Lesser Apple Leaf Folder, by R. L. WEBSTER. Iowa Agric. Exp't Sta. Bull. 102, p. 179–212, 1909.

This admirable biological study, illustrated by a number of original figures and plates of a comparatively little known insect, *Peronea minuta* Rob., makes material additions to our knowledge of this species and methods of controlling it. The arrangement of the matter diverges from the usual, in that a discussion of control measures follows the account of its injuries, the portions treating of classification, the life history and the discussion of natural enemies being relegated to a less conspicuous part of the bulletin.

Scale Insects of the Orchards of Missouri, by E. P. TAYLOR. Mo. St. Fruit Exp't Sta. Bull. 18, p. 1–87, 1908.

This is a general discussion, with special reference to the San José scale and the more destructive scale insects of the orchard, together with a few allied forms, such as the grape scale, *Aspidiotus uvæ*, walnut scale, *A. juglans-regiæ*, and the cottony maple scale, *Pulvinaria innumerabilis*. A number of experiments with the San José scale are summarized, the author giving decided preference to lime-sulfur washes though admitting the usefulness of miscible oils. This summarized account will be particularly serviceable to fruit growers.

The San Jose Scale in Arkansas, by C. F. ADAMS. Ark. Agric. Exp't Sta. Bull. 102, p. 221–236, 1908.

This summarized account, designed especially for fruit growers, discusses in some detail remedial and control measures, giving particular attention to nursery inspection and the necessity of a better law for regulating the same.

Lime-Sulfur Mixtures for the Summer Spraying of Orchards, by W. M. SCOTT. U. S. Dep't Agric., Bur. Plant Indust. Cir. 27, p. 1–17, 1909.

This summarizes to date the status of these preparations as summer sprays. Professor Scott restricts his circular to statements of the results obtained in controlling fungous diseases affecting peach, cherry and apple, comments upon the injury to the foliage from these preparations and with commendable conservatism allows fruit growers to draw their own conclusions.

The Hop Flea Beetle, by F. H. CHITTENDEN. U. S. Dep't Agric., Bur. Ent. Bull. 66, Prt. 6, p. 71–92, 1909.

This is a detailed account, with numerous original illustrations, of the hop flea beetle, *Psylliodes punctulata* Melsh., a species quite injurious to hops on the Pacific coast. Notes are given on a number of related species. There is an extended discussion of control methods, including several new mechanical devices for the capture and destruction of the pests.

The Grapecane Gall Maker and the Grapecane Girdler, by F. E. BROOKS. W. Va. Agric. Exp't Sta. Bull. 119, p. 321–39, 1909.

These two little known insects, *Ampeloglypter sesostris* Lec., and *A. ater* Lec., are discussed in detail, the accounts being illustrated by an admirable

series of original figures and process reproductions. The author is to be congratulated upon having made substantial additions to our knowledge of these two forms.

The Semitropical Army Worm, by F. H. CHITTENDEN and H. M. RUSSELL. U. S. Dep't Agric., Bur. Ent. Bull. 66. Prt. 5, p. 53–70, 1909.

This bulletin gives in detail the life history and habits of *Prodenia eridania* Cram., a common southern injurious species which appears to have hitherto escaped notice to a large extent. The insect and its operations are admirably depicted by a series of original illustrations.

Whitefly Studies in 1908, by E. W. BERGER. Fla. Agric. Exp't Sta. Bull. 97 p. 41–71, 1909.

This is a revision of Bulletin 88, with important additions. A most interesting feature is the discussion of the various fungi affecting white flies and the description of a new species, *Aleyrodes nubifera*, previously confused with the common *A. citri*.

Biological Studies of Three Species of Aphididae, by J. J. DAVIS. U. S. Dep't Agric., Bur. Ent. Tech. Ser. No. 12, Prt. 8, p. 123–68, 1909.

An extended biological study of the corn root aphis, *Aphis maidi-radicis* Forbes, the corn leaf aphis, *Aphis maidis* Fitch and the sorghum aphis, *Sipha flava* Forbes. The life history of each species has been worked out in detail, the food habits, the number of generations and the productivity of each being indicated by a series of admirable tables. Each account is accompanied by an extended bibliography. The presentation of a large amount of data in such a concise and comprehensive manner is most admirable.

Economic Loss to the People of the United States Through Insects that Carry Disease, by L. O. HOWARD. U. S. Dep't Agric., Bur. Ent. Bull. 78, p. 1–40, 1909.

This comprehensive discussion from a broad viewpoint treats particularly of malaria, yellow fever and typhoid fever and the losses caused by the dissemination of these infections through the agency of certain insects. The chapter on endemic diseases and their effect on the progress of nations from Ross, with Doctor Howard's comments thereupon, is a most fitting conclusion to an admirable summary of the situation. This bulletin should be widely read by laymen as well as by professional men.

Fruit Trees and Their Enemies, with a Spraying Calendar, by SPENCER PICKERING and FRED V. THEOBALD, p. 1–113, 1908.

This is a summarized account, admirably printed on good paper, of the various enemies affecting fruit trees, including not only insects and fungi but birds, mammals and frosts. The introductory matter, while important, is relatively much more extended than the necessarily very brief discussions of the various species. Judged from the American standpoint, the work would

have been greatly improved by a series of figures showing the characteristics of the more important insects and fungous diseases. It will undoubtedly prove very useful to fruit growers of Great Britain.

The Warble Fly, by GEORGE H. CARPENTER and J. W. STEEN. Dep't Agric. & Tech. Instruct. for Ireland Journ. vol. 8. No. 2 Separate, p. 1–22.

This is a general discussion, illustrated by a series of excellent figures, of the warble flies, *Hypoderma bovis* and *H. lineata*. The details of a series of experiments with various washes and other protective measures are given, one of the most interesting being data showing that calves with the legs covered from June to September were infested on the average by only 3.5 warbles, as opposed to an infestation by ten warbles in the case of calves with the back and sides protected. The authors consider the destruction of the maggots as the most practical method of dealing with these pests.

Injurious Insects and Other Animals Observed in Ireland During the Year 1907, by GEORGE H. CARPENTER. Royal Dublin Soc., Econ. Proc., vol. 1, p. 559–588, 1908.

This comprises brief illustrated notices of many insects observed during the season, with somewhat extended discussions of the cattle tick, the scab and itch mites and the pear blister mite. The value of the report is greatly enhanced by a series of original process plates.

South African Central Locust Bureau, First Report of the Committee of Control, edited by CLAUDE FULLER, p. 1–112, 1907.

This is a noteworthy document in that it places on record the progress made by a group of administrations toward subduing a common enemy. The leader in this movement was the late C. B. Simpson, unfortunately deprived from taking an active part in the operations by an untimely decease. The official history dates from a dispatch June 1, 1906, and a conference held the following August between representatives of a number of administrations. This resulted in the drafting of a series of resolutions providing for a central bureau at Pretoria and its maintenance by contributions from the interested governments. Provision was made for a secretary and the tabulation by him or under his direction of data relating to the distribution and movements of locusts. The two troublesome species are the red winged locust, *Cyrtocanthacris septemfasciata* and the brown locust, *Pachytylus sulcicollis*. The need of coöperation was due to the swarms of locusts deserting extensive wild tracts for the more attractive cultivated areas. An interesting biological phenomenon is the persistence in the soil of viable eggs for a period of several years. The possibility of this, a matter of common belief, was recently determined by Professor Lounsbury. There is an interesting chapter on the food value of locusts. The destructive swarms are controlled most readily and economically by spraying the vegetation in their vicinity with a sweetened arsenical solution, precautions being taken to keep stock from the treated area till the arsenic has burned and killed the grass or until a heavy rain has washed it off. The problem of South Africa appears to be very similar to the locust evil of South America and to that which obtained in the West

some years ago. Several of the colonies have enacted a legislation designed to compel coöperation in the locust fight, while others provide assistance to individuals conducting a warfare against the common enemy.

Current Notes

Conducted by the Associate Editor

The Associate Editor has taken up work at the Gipsy Moth Laboratory, Melrose Highlands, Mass., for the summer and all communications should be sent to the above address and not to Washington, D. C.

Prof. Herbert Osborn has been granted leave of absence for one year at the Ohio State University and arrangements made for him to investigate certain insects injurious to cereal and forage crops for the Bureau of Entomology.

Mr. F. D. Couden of the Bureau of Entomology gave a short course on elementary entomology to the students at the Biltmore Forest School, Biltmore, N. C., during the month of May.

Prof. J. M. Stedman has resigned the position of state entomologist of Missouri to accept an appointment with the office of experiment stations, Washington, D. C.

Mr. C. T. Brues, curator of the Department of Invertebrate Zoölogy, Public Museum, Milwaukee, Wisconsin, has been appointed instructor in entomology at Harvard University vice Mr. Paul Hayhurst resigned. Mr. Brues will begin work in his new position September 1, and after that date his address will be Bussey Institution, Forest Hills, Boston, Mass.

Prof. W. M. Wheeler has in press a new book entitled "Ants, Their Structure, Development and Behavior," which is being published by the Columbia University Press. This book will appear early next fall, and will contain much new and valuable information concerning this interesting family of insects.

At the last session of the Ohio legislature an appropriation of $6,950 was made for the Department of Entomology of the Ohio Agricultural Experiment Station for the fiscal year ending March 1, 1910. Three assistant entomologists will be employed in the future. Mr. J. S. Houser has been appointed first assistant, while Mr. W. H. Goodwin and Mr. L. L. Scott will fill the other positions. Mr. Scott is a graduate of the Ohio State University and will take up an investigation of bark beetles injurious to fruit trees. Other imporant lines of work will be an investigation of spring and fall canker worms, the wheat joint worm, shade tree pests, the woolly aphis and demonstration work in spraying.

The total returns from one acre of Ben Davis apple trees at Erlin, Ohio, sprayed last year by the station entomologists amounted to $1,400 and the net profit was $1,000. Demonstration orchards will be treated this year in all sections of the state.

Prof. G. P. Clinton, Mycologist of the Connecticut Agricultural Experiment Station, has sailed for Japan for the purpose of studying the fungous diseases

which affect the gipsy moth, with a view to introducing them into the infested district in Massachusetts. The trip is being undertaken by Harvard University in coöperation with the state of Massachusetts, and it is hoped that the importations received will be of great value in decreasing the gipsy moth in badly infested sections.

The Department of Entomology of the University of California has for several years past held four conferences during the school year at stated intervals, the place alternating with Berkeley. Thus during the last school year four such conferences were held, two at Berkeley, one at Watsonville and another at Davis. The last of these meetings held in Berkeley was planned to be more inclusive, inasmuch as entomologists from the entire Pacific Coast were invited to attend and present papers. The hope was also expressed that a special organization of western entomologists might be effected inasmuch as the insect problems of the Pacific Slope are so different from those on the other side of the Rocky Mountains.

At this meeting, held April 20 to 23, the following general program was carried out: Tuesday afternoon (April 20), "Lime Sulfur, Its Use and Manufacture"; Tuesday evening, "The Manufacture of Miscible Oils and Arsenical Insecticides"; Wednesday morning (April 21), "The European Elm Scale and the Codling Moth"; afternoon, "The Orange Scale and the Citrus Mealy Bug"; evening, exhibits of insecticide materials, insect collections, apparatus illustrating methods of study, etc.; Thursday morning (April 22), visit to Oakland formicary; afternoon, "Forest Insects and Apiculture"; evening, "Medical Entomology"; Friday morning (April 23), "Methods Used in the Study of Sensory Reactions, Insect Photography"; afternoon, permanent organization.

The meeting was well attended notwithstanding the enormous distances separating the workers on the Pacific Coast. As had been hoped at the outset, a permanent organization was effected under the name of Pacific Slope Association of Economic Entomologists. The constitution adopted requires that active membership shall be limited to the official and professional entomologists of the Pacfic Slope, while associate membership shall be open to agriculturists and to all others interested in the objects of this association. The following officers were elected, viz.: President, Professor C. W. Woodworth, University of California, Berkeley, Cal.; vice-presidents (representing each state concerned), Prof. R. W. Doane, Palo Alto, Cal.; Prof. S. B. Doten, Reno, Nevada; Prof. J. Elliott Coit, Phœnix, Arizona; Prof. Fabian Garcia, P. O. Agricultural College, New Mexico; Prof. E. D. Ball, Logan, Utah; Prof. A. B. Cordley, Corvallis, Oregon; Prof. A. L. Melander, Pullman, Washington; Prof. L. F. Henderson, Moscow, Idaho; Prof. C. P. Gillette, Fort Collins, Colorado; Prof. R. A. Cooley, Bozeman, Montana; Prof. Aven Nelson, Laramie, Wyoming; Hon. Thomas Cunningham, Vancouver, B. C. Executive Committee, Mr. R. R. Rogers, San Francisco, Cal.; Mr. H. P. Stabler, Yuba City, Cal. Mr. L. H. Day, Oakland, Cal.; secretary-treasurer, Prof. W. B. Herms, University of California, Berkeley, Cal.

It is planned to hold the next meeting this summer at Portland, Oregon, in conjunction with the American Association for the Advancement of Science.

W. B. HERMS, *Secretary-Treasurer.*

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MEDICAL ENTOMOLOGY, ITS SCOPE AND METHODS[1]

By WILLIAM B. HERMS, *University of California*

The importance of the study of insects in many departments of human interest is being the more fully recognized as science reveals the facts of inter-relationships, both advantageous and destructive. The principal concern has been with the control of insects destructive to farm crops, and well it has been, in view of the many millions of dollars lost annually by insect ravages. Students of animal husbandry and of veterinary medicine are fully awake to the losses incurred by insect pests. Mosquitoes and flies have for centuries past been looked upon as a source of extreme annoyance to the human family, but that these insects might be transmitters of disease was hardly even suspected until the latter part of the last century, when Dr. A. F. King presented his arguments before the Philosophical Society at Washington, D. C. That insects and arachnids of a given species might be the sole transmitters of a specific disease and what is more, a necessary factor, inasmuch as these insects serve as intermediate hosts, was not considered seriously until the last five years of the last and the beginning of this century, when Smith and colaborators showed the existing relation of the cattle tick to texas fever and Laveran, Ross, Grassi and others the rôle of mosquitoes in malaria. Today our knowledge of the transmission of diseases by insects has been greatly increased by the work of a host of investigators. Among other specific cases we know that malaria is transmitted by mosquitoes of the genus Anopheles, yellow fever by mosquitoes of the species

[1]A paper presented at the Pacific Coast Entomological Conference convened in Berkeley, California, April 20–23, 1909.

Stegomyia calopus, Bubonic plague by several species of fleas, notably the rat fleas, *Pulex cheopis* and *Ceratopsyllus fasciatus;* typhoid fever conveyed in part by the housefly, *Musca domestica,* which is also a transmitter of cholera and pretty surely of tuberculosis; anthrax by horseflies, certain forms of opthalmia by flies of the genus Hippelates, various forms of Trypanosomiasis by the stable fly (Stomoxys sp.), and the Tsétsé flies of the genus Glossina, Texas fever by the Texas fever tick (*Margaropus annulatus*). This list could be considerably increased by other references, but let us merely add to it a few examples of insects living parasitically in some form or other and producing severe and often fatal forms of irritations, such as the lice (Pediculidæ), the cone noses (Reduviidæ), the bed-bugs (Acanthidæ), the bot flies (Œstridæ), the screw worm flies (*Chrysomyia macellaria*), etc.

The facts as presented by the study of the above inter-relationships are being accepted by the medical profession of today with much less skepticism than evidenced even ten years ago. The great trouble is that the average practising physician cannot keep up with the scattered work done in this field. Several workers have attempted to place much of this material within reach of students in the same field, notably Nuttall, Braun and Osborn. To the writer it is evident that the time has come when the study of insects and their relation to disease must be placed on a more independent footing and the subject treated in a more systematic manner, in order to provide medical and veterinary students and practitioners with a better knowledge of the matter. In treating the subject of medical entomology I have departed somewhat from the usual method. Ordinarily the subject is covered in a few lectures on disease-transmitting insects in connection with general entomology or general zoölogy or parasitology, in which latter cases the habits and systematic relationships of the insects are treated more fully. There exists today rather a lack of responsibility. Whom shall we hold responsible for the study of disease-transmitting insects, the entomologist, the physician, the veterinarian or the bacteriologist? While I believe in coöperation as the solution of many scientific problems, it is also a fruitful source of disappointment, since there are many important matters which are often lost somewhere between the coöperators. It may be that we should be farther along relative to preventive medicine, and particularly in regard to diseases transmitted by insects, had not phases been lost somewhere between the followers of the professions already named, each fully engaged in his own work, the duties of which are pretty well outlined. There is need of men specifically prepared, upon whom can

be placed the duty and responsibility of investigation relating to the questions under consideration, men who are not only equipped entomologically, but who also have a knowledge of certain diseases and of the pathogenic organisms to be dealt with, and the laboratory methods involved. Therefore in developing the subject of medical entomology it has been my aim to construct the work from this viewpoint. That this conception seems to have met with favor by physicians and veterinarians is evident from the many opinions already voiced in many parts of this state and elsewhere.

Health officers and supervisors of hygiene have already recognized the value of such special training, and are freely calling on our department for aid and advice.

Methods

In teaching this subject, much careful attention should be devoted to the study of insect mouthparts, upon knowledge of which rests the proper interpretation of disease transmission. Enough attentention must be paid to general structure to aid in classification. Internal anatomy should deal principally with the organs of digestion, including the salivary glands and canals. Usually the latter phase can be dealt with in specific cases. The importance of this knowledge should be impressed upon the mind of the student at once, and this can be made more weighty by calling attention to the widely different mouth structure of two closely related Diptera,—the housefly and the stable fly—consequently differing widely in their powers of disease transmission. By judicious lectures and demonstration covering two periods the contradistinction between bacteria and protozoa may be impressed. The various insects to be discussed may be conveniently taken up in the usual systematic order. It has been my plan to discuss family characteristics and follow this by a sub-topic, for example, "Mosquitoes and Malaria," treating the matter under several headings, *viz.:* Historical. What Is Malaria? What is the Pathogenic Organism—Its Life History? How Transmitted? Characteristics of Anopheles, Life History and Habits, Methods of Control. Thus, with necessary deviation, the list of disease-transmitting insects, including other insect and arachnid, parasites of man and domesticated animals may be considered. It is planned to segregate the subject-matter into two divisions, the medical and the veterinary, and thus we are better able to devote more attention to each subdivision. The aim of our work should never be lost sight of,—the *control* of disease-transmitting insects.

In the laboratory the insect should be studied from all possible view-

points. We need more knowledge with regard to the sensory reactions of insects, their relation to chemicals, to temperature, to light, to vibrations. We need to know more about the mouth structures, the foot structures and the actual method of disease-transmission. It is essential that the student become familiar with the habits and habitat of the insect in the field, its life history under normal and unusual conditions. This plan has been followed out in our study of the houseflies and the flesh flies, and it is upon such knowledge that our present campaign against the housefly in Berkeley rests. Thus we are also developing our work on the fleas, the mosquitoes, the fruit flies, the stable fly, and the Texas fly.

PUBLICATIONS OF THE STATION ENTOMOLOGIST

By E. Dwight Sanderson, *Director and Entomologist, N. H. Experiment Station*

The matter published by the Station Entomologist divides itself naturally into three classes—that published primarily for the information of his constituents and embodying matter which does not necessarily originate with him; second, reports of experiments and investigations made; and third, technical scientific articles. This matter is published in a variety of forms, as circulars, press circulars, bulletins, annual reports and articles in technical periodicals. The whole matter of the best methods and system for Station publications is now in such a state of development that it is impossible to lay down any principles with which all will agree, and the speaker merely wishes to attempt to outline some principles which seem to be generally supported by the Stations having the better class of publications.

First let us consider the bulletin, for it is "par excellence" the publication characteristic of the American Experiment Station. In the past the bulletin has included almost anything from a general compilation of various injurious insects, with the remedies for the same, to a bibliography of some group of insects or an account of some pest, giving its anatomy, embryology, etc. etc. More and more we have come to feel that the bulletin should be essentially a farmer's publication. In its construction the writer should constantly strive to put the matter in such shape as to attract and interest the reader. We should prefer a bulletin not over 32 pages long, certainly never over 48 pages and preferably a single form of 16 pages, except where a general handbook, such as a manual of all the insects injurious to fruits or garden crops, or something of that sort, is to be published for

reference work. The bulletins should be made as attractive as possible. This is not always within the control of the entomologist and many of the other points to be mentioned cannot always be determined by him, but if he be a man who is interested to present his work in the best form, he can usually have considerable influence over the form and make-up of his publication. The title page of many of our Station publications at once consigns them to the waste basket. The type is poorly selected and their general appearance is forbidding. One often has to study the title page before he can ascertain the subject of the bulletin. The subject should stand out distinctly and should be attractively stated. A small illustration characteristic of the subject matter adds much to the appearance.

There are a few constantly occurring classes of bulletins which merit brief comment. The bulletin which includes a discussion of a number of totally unrelated insects may be useful for reference, but in most cases the account of the various insects would be much stronger if put into separate short bulletins dealing with that pest only. This of course does not apply to bulletins dealing with the insects affecting some particular crop. Second, the bulletin which deals with the Insects of the Year. It is doubtful whether such bulletins are very generally read by the agricultural public: They are of interest and of great value to the entomologist and find a very proper place in a report or a paper before the Association of Ecomomic Entomologists. Usually they merely serve to show what the entomologist has been doing during the year and are more or less padded in order to make some report of the entomological work during that season. The bulletin which deals exhaustively with some pest, going so far as to include its anatomy, embryology and other technical details, is probably never read by the average farmer and this wealth of technical detail merely serves to confuse him and makes it difficult for him to separate the wheat from the chaff as far as use is concerned. There are some other matters commonly included in Station bulletins which it seems to the writer might well be omitted and placed in annual reports or in technical publications. For instance, lengthy bibliographies or a list of insects is of no service whatever to the average agriculturist tho exceedingly valuable to the entomologist. One should always have in mind that these bulletins are published in large editions and that it is much better to consign such technical matter to publications printed in small editions and circulated among those whom they will benefit. These suggestions do not of course apply to bulletins which are published as those of the New York State Experiment Station, which are circulated among a com-

paratively small number of farmers and to Experiment Station workers, and which are republished in an abridged form for the general agricultural public. This ideal arrangement has not been possible as yet for most of the Stations.

If the bulletin is to be read it must be made attractive and there is very little use of printing large editions and giving them wide circulation unless they are read. With the surfeit of agricultural papers and popular magazines now to be found on the table of every farmer who reads at all, there is little chance for the station bulletin unless it be put in attractive form. One of the first considerations is typography. This, again, is not always within the control of the entomologist but he can at least prevent glaring errors. The main headings should be in type which will strike the eye and clearly subdivide the important parts of the publication. Smaller type should be used for the sub-headings and those paragraphs which it is desirable to bring forcibly to the attention of the reader. Care should be taken that headings of equal value should be in similar type. To secure uniformity in this regard the N. H. Station has recently adopted a style board or sheet showing the typography in use in its publications. This has been in use to the writer's knowledge in some other stations and is found to be exceedingly helpful in the preparation of manuscript for the printer and aids very much in securing a uniform appearance in all the publications of the station. If there be no uniform rule for all the Station's publications, the entomologist may well make up one for himself. Extremes in the use of typography are often seen, both thru lack of its appreciation as well as carrying it to excess. In some the headings are of a uniform type whether they be of more or less importance, while in others there is such a multiplicity of styles of type as to make the publication look more like an advertising sheet than a bulletin and which are decidedly unpleasing from a typography standpoint. Examples of these may easily be found but in looking over files of our publications, two have happened to particularly come to the notice of the writer. A concise, logical and well paragraphed summary printed in black face type, either at the beginning or the end of the bulletin is of great aid to the reader and will often insure a further reading of those parts of the publication in which he is interested.

Illustrations are a matter of the greatest importance in securing an attractive bulletin. Half-tones are at present the most desirable and popular form of engraving where they can be used. Half-tones should always be put on calendered paper and where many are to be used, 70 lb. super-calendered will give the best results and is the

weight used by most of the best stations. A good half-tone cannot be made from a poor photograph. If your photograph is thin, muggy and lacking detail, do not try to have it engraved, as your efforts will be doomed to failure. Again, no matter how good the photograph or engraving, if the paper be poor or if, worse, you have a poor printer, do not try to do much with half-tones. Many of our bulletins would be better without illustrations than with the ink splotches now inserted with long legends explaining to the reader that in such and such a part of the cut there is supposed to be an insect, or which totally fail to bring out the point which it is desired to illustrate. The illustrations have two purposes: First, to show the appearance of insects or plants etc., which can be more readily illustrated than described, and second, to hold the attention of the reader and reinforce the text. The American public is becoming used to reading in pictures, due to the catering of most of our leading magazines to its taste for pictures, and we may as well recognize that the average man reads as much thru the pictures as he does thru the text. If possible, have the illustrations come on the same page as the text referring to them. Very often a small illustration of some stage of the insect inserted at the point of its description in the text is much more effective than when tucked away in a plate with many other figures at the back of the bulletin. Make the legends of the figures as interesting as possible. Very often a cut may be made much more attractive by cutting out the background, especially when the background is gray and tends to obscure the main point of the illustration. Variety is given the illustration by vignetting the backgrounds which gives a pleasing contrast to the uniformity of square edged cuts. Both the cutting out of backgrounds and vignetting can be done by any good engraver but should not be attempted unless the ability of the engraver is known. Where poor paper is used and good press work cannot be secured on the text, half-tones should be put on coated paper inserts. Much better printing can be secured on such cuts, in any event, than where they are placed in the text with the type, but it is then necessary to bring the cuts together in one place rather than to distribute them thru the text as suggested above. In assembling illustrations for a full-page plate it is best to mount the prints on one sheet and have one solid plate made by the engraver, rather than a number of small cuts. To secure good printing the prints for one plate should be of about the same density, as good results will not be secured where very black and very light prints are placed together on one plate. The different figures in the plate, if it be made up of parts, are usually shown up better if a black line be run around each

and the intervening spaces be cut out so as to leave a perfectly white margin between the different parts. The lettering of figures can usually be done more neatly by the engraver's artist than by the entomologist and may be readily indicated by pasting a loose sheet of thin paper over the front of the plates and marking on it the lettering at the exact point where it is wished. Plain plates are much to be preferred to the artistic scroll work and embellishments formerly employed by some of our engravers. The plate should always be small enough so that the legend may be placed immediately beneath it. A plate put in the front of a bulletin with others scattered thru it and then the legends tucked away on the last page are inconvenient for the reader and probably very often the legends remain unread.

For very many purposes line drawings are much to be preferred to half-tones and it is to be regretted that we have become so infatuated with the ease of the photographic process that most of us decline to take the time to make presentable drawings where we do not have artists at our command. Undoubtedly a reaction in this matter will soon occur. But even with the line drawings, if they cannot be reasonably artistic they had better be omitted. The man who reads the Station publications usually has some sense of the proprieties and a crude drawing will hardly appeal to him as in keeping with the reasonable dignity which should accompany the publications of a scientist.

Arrangement.—The arrangement of the bulletin should be logical and with a natural sequence. A brief introduction pointing out the general importance of the subject considered, followed by a short historical sketch and a brief consideration of the extent of injury due to the pest, may well occupy the first page or two. The life history is generally the key to the methods of control and should follow. The various stages of the insect should be distinctly but briefly described and figured. In very many cases it will elucidate the life history to the reader if the method and place of hibernation be first described and the various stages and transformations of the insect thru the season be followed thru the summer until it again goes into hibernation. One of the things most difficult for the average man to understand is the number of generations and the transformations of an insect and this should therefore be made as clear as possible. The description of the various stages may well be placed at their respective points in the discussion of the life history, rather than being separated and the different stages described separately. The different stages of the life cycle is often made clear by an illustration such as has been frequently used by various entomologists

showing the different stages in a circle as has been done by Prof. Slingerland in the case of the Grape Leaf Hopper, by the writer with the Gipsy moth and by numerous others. The descriptions of the various stages should bring out pointedly the characteristics by which they may be recognized and should stop there. The farmer cares nothing for the technical detail and the descriptions will be of much more value to him if they merely enforce one or two points whereby that stage of the insect may be distinguished. The habits of the various stages of the insect should be described at the proper points in its life history and special emphasis should be laid upon those habits which have to do with the means of control, making them perfectly clear in the discussion of the life history and then referring back to them when considering the control. The detailed results of exhaustive studies of the time consumed in various stages etc., is not a matter of interest to most farmers. They wish to know the approximate length of the various stages as related to the means of control, and the average length of any one stage and the usual habits, except where variation due to season, climate, etc. is a matter which must be taken under consideration in control work. Such reports of exhaustive studies of the various stages of an insect may better be included in an annual report or in a technical article.

Very often a considerable portion of a bulletin is given up to a consideration of parasites and predaceous enemies. This has always seemed to the speaker to be a matter of doubtful importance to the average reader. It is undoubtedly desirable to point out that ladybird beetles are not giving birth to plant lice upon the apple and that the fruit grower should protect them, and wherever parasites may be in any way artifically encouraged that should be mentioned and their exact importance fully outlined. But is it of any consequence whatever to enumerate the different species of parasitic insects which affect the insect and describe them with the detail usually given? Or is there any reason for publishing a description of a new species of parasite in a Station bulletin? We are coming to appreciate that in many cases parasites may be artificially encouraged and wherever that can be done it should be given due prominence, but attention constantly called to parasites in many cases leads the farmer to have an exaggerated opinion of their practical importance.

Scientific names may well be used with caution and it is a question whether it would not be better to use common names wherever possible and relegate the Latin name to a foot note where it will be available for the entomologist.

The Means of Control are of course the part of the publication

which vitally interests the farmer. Concise discussions of experiments performed may well find a place under this head, but the average reader will be satisfied with a well summarized discussion of these results and with the conclusions drawn from them fully as well as if all the data upon which they are based be submitted, for he will accept the judgement of the writer and will rarely study all the details. It is of course important that due prominence be given to these experiments as they show the experimental work done by the writer.

Under Means of Control a definite distinction should be made by headings between those which are *preventive* and those which are *remedial*. More and more we are laying emphasis on preventive measures and we should aid the reader to distinguish between prevention and remedy. Under both of these heads, sub-headings should indicate clearly against what stage of the insect the preventive or remedy is effective and the action of the preventive or remedy should be clearly explained. Definite descriptions of the use of the preventive or remedy should be given so that it may be followed easily by the reader untutored in such matters.

The bulletin may well close with a few references to the more important publications available which might be consulted by those who wish further information upon the subject in hand, but the long bibliography is of no value to the average reader. With the short bulletin, if it is well summarized, no index is usually necessary providing the different parts have been well indicated with proper type.

Spray Calendar.—A publication which has always been popular has been the spray calendar. It is a sort of farmer's encyclopedia of practical entomology and plant pathology and is one which will constantly be open to improvement. It is a question whether the original style of calendar form is the most desirable and we have noticed that many of the stations are now issuing Directions for the Treatment of Insect Pests and Plant Diseases, rather than a spray calendar. The idea that a definite calendar can be issued by which the agriculturist can fight his pests according to some rule, is an exceedingly enticing one but one which hardly tends to encourage him to secure that understanding of a pest which is necessary for its intelligent and successful control. It is the writer's belief that the form of publications now being issued by Cornell, Geneva and other stations, giving concise descriptions of the pests arranged under the crops that they attack, with brief suggestions for remedies, and then a description of the various insecticides and other means of insecticidal control, is much better than the calendar form.

A form of publication now becoming deservedly popular is the circular. This may be a brief report of some station experiments or the abstract of a bulletin, or more usually merely a short account of some pest compiled from other sources. The object of the circular is usually distinctly educational. It should be brief and written in a crisp, readable style. Only necessary illustrations should be used. The circular finds its chief usefulness for answering correspondence, where there are numerous inquiries concerning some one insect not discussed in other station publications. The circulars of the Bureau of Entomology, Colorado, New York and Ohio Experiment Stations may well illustrate a desirable type of circular, though those of the latter station are often of such a length that there seems to be no clear distinction between a circular and a bulletin.

Both bulletins and circulars are often almost wholly compiled from the writings of others, and such publications are warranted if they are needed by the station's constituents. But be generous with credit in such publications. Where the accounts of life histories and description of remedies are from some particular author and are not matters of general entomological knowledge credit them to that author and do not make it appear as original with you. Give full and generous credit to the work of assistants. No one ever belittled himself in the eyes of his colleagues by over generosity in this matter, and the man who is free with his credit never fails to receive all the recognition due him for his own work. Furthermore, recommendations are often made on the authority of another, whose efficacy is not known to the writer, and accrediting them to the original author tends to protect the writer if they do not prove satisfactory.

The Press Bulletin in one form or another is now a regular feature of some stations. In many stations the idea of the press bulletin and circular seem to have been confused. The press bulletin must be written in newspaper style if it is to command the attention of the editor and reader. It should be not over 1,000 words long, and preferably not over 600 or 700 words. Illustrations are superfluous. If the publication is designed for answering correspondence primarily make it a circular and send it to those papers which are known to desire such matter, but sending numerous so-called "press bulletins" of four pages or more to the average editor tends to discourage publication of such matter. The press bulletin may as well be printed with the same size page and type as bulletins and is then in form for binding if preservation is desired. Ordinary type is also preferable to the fine newspaper type often used. Where not over one hundred papers are to be reached the press bulletin may as well be

run off on a copying machine as to be printed. It is our custom to send out press bulletins a week ahead of the desired time of publication and to clearly state a date when they are released for publication in weeklies and dailies, thus avoiding premature publication in dailies.

Annual Reports.—Many stations are publishing only a financial and brief executive report, while others are giving a full report of the work of the various departments without any republication of bulletins. The Connecticut Station has an excellent custom of publishing its report in parts, making the reports of each department a separate portion of the annual report, so that it can be printed and circulated separately. There is a good deal of work done at every station which should be reported for the use of station workers much more fully than it is desirable to do in a bulletin, and it would seem that the station report might form a satisfactory place for a full report of the work of each department. This report may give all those scientific details, descriptions of methods used, etc., which would have no place in a bulletin for the farmer and which are not acceptable to most of the technical periodicals. The annual report need have but little reference to the popular taste; it is not prepared for the farmer. But it should be in good form and carefully organized.

The typography should be that ordinarily used in good book-making, and should merely make clear the relation of the different parts of the report without any attempt to attract the eye. The various lines of work in progress and to be reported upon should be briefly mentioned at the beginning of the report and each line of work should then be treated separately. In the discussion of an insect to be reported upon fully, its past history may well be considered in some detail, and full descriptions should be given under the various stages, with the details of its life history and a complete bibliography. In other words, a full and complete report may well be published in an annual report; but it is unnecessary to go into excessive details on any of the fine points, for even the entomologist wearies of this, and frequent summaries will command his attention and should be used freely. Tabulating the results is always helpful in placing a large amount of information in a small amount of space, where it can be readily grasped by the reader.

The illustrations in the annual report should be prepared so as to show the details of the insect under discussion and need not be prepared with any reference to their artistic effect except so far as they clearly illustrate the desired point. They may well be assembled

in plates if this be more convenient and several plates may be inserted together in a report, lessening the cost of the publication.

In addition to the matter which may be published in the annual report there is often considerable technical work of the station entomologist which he wishes to publish in entomological journals or other technical periodicals. The number of such technical papers will undoubtedly increase in the future. At the New Hampshire station we have just adopted the policy of having a number of separates of such papers printed at the expense of the station and having all such papers labeled "Scientific Contributions from the N. H. Agricultural Experiment Station, No. —." The scientific articles of the station staff will be numbered serially and will be sent to the libraries of the other stations, and a select list and a number of copies will be kept and bound when a volume accumulates.

Of course it is hardly necessary to add that the natural tendency of some of us to rush into print is a matter which should always be guarded against in all of our publications. Most of us have been guilty in this regard, but there seems to be more conservatism on this point than formerly, and we trust that all may profit by the only too apparent errors of many of our colleagues in premature publications. Be absolutely sure of your conclusions before publishing them, and if the publication be merely a report of progress make it very clear that the results are merely those of one year's work, that they should not be relied upon conclusively, and do not draw undue conclusions from the work of a single season. The drawing of unwarranted conclusions from one or two years' work is not particularly a matter of publication, as it has to do with the temperament and judgment of the individual and is therefore not necessarily within the province of the speaker, but much injury has been caused in economic entomology by the over-use of printing.

As a whole, the general tone and quality of the publications of our station entomologists have made a very decided improvement in the last ten years, and in the last five years we have seen very marked advance in the quality of work, and as a consequence in the publications of our economic entomologists. We believe that this will go on and that with the large publication constantly looming up before us we shall be forced to pay more attention to the method and form of presentation.

A PARASITE ON THE ASPARAGUS BEETLE

By H. T. Fernald, *Amherst, Mass.*

The unfortunate freedom of the asparagus beetle *(Crioceris asparagi* L.) from parasites in this country has often been remarked. It was with much interest therefore, that on June 2 of the present year the writer observed several tiny Chalcids running about on asparagus stalks, and after a few minutes observed one ovipositing in the egg of an asparagus beetle. Several of the parasites were captured and a specimen was sent to the Department of Agriculture at Washington where through the kindness of Dr. Howard and Mr. J. C. Crawford it was determined as belonging to the genus *Tetrastichus,* but in too poor condition for specific location.

The parasites are very small, measuring from two to a little less than three millimeters in length, and when seen in the sunlight as they move about are brilliant metallic green in color, particularly on the abdomen.

Their actions on the plant were carefully studied and gave the impression of stupidity on the part of the insects, for though plainly searching for beetle eggs they would frequently pass within two or three millimeters of them without being apparently aware of the fact. They would travel up and down the main stems and branches, rarely pausing, though giving no appearance of haste, often covering the same ground several times and examining eggs they had already looked over, as though entirely unaware that this was the case. They were not easily disturbed and could be closely watched with a pocket lens, the shadow caused by the head and hands of the watcher having no effect.

Apparently about one egg in every eight or ten examined proved acceptable, and the parasite after a short period (for consideration?) moved out on the egg which was long enough to permit it to support the parasite. The insect then slowly bent its abdomen and inserted its ovipositor in the egg where it remained for five or ten seconds, after which it was withdrawn and the parasite resumed its travels.

A number of eggs were seen to be punctured in this way and the parasites were by no means difficult to find for about a week. Later they disappeared, or at least none were captured till July 12, when one was captured, and others were found the following day.

At the time of the first discovery of the parasites, the asparagus beetles were abundant and eggs were extremely so. During the following month the weather was favorable for the development of these

pests and no treatment for them was applied to the field. In spite of this, the larvæ were far from abundant, and at the present writing (July 15) hardly any specimens of the insect in any stage can be found. It is probable that the pupal period for the first generation of beetles is about completed, and the reappearance of the parasites would suggest that they will be on hand for the next generation. In any case, despite a great abundance of beetle eggs in June, the larvæ were not abundant under conditions seemingly favorable in every way and it is not improbable that this was in a large measure due to the attacks of the parasite.

Similar conditions, and the presence of the parasite at Concord, Mass., accompanied by a great reduction in abundance of larvæ of the asparagus beetle there also, indicate that the parasite may be present over a considerable territory and that it may become an efficient enemy of the beetle in this country.

Comparison of specimens of the *Tetrastichus* with the descriptions of all the American species of this genus, leads the writer to the opinion that it is likely to prove undescribed, but not being familiar with the group, he has sent specimens to the Department of Agriculture for description or final identification by the specialists there.

A NEW TREATMENT FOR WIREWORMS

By H. T. Fernald, *Amherst, Mass.*

For several years wireworms have been very injurious to corn seed when first planted, in Massachusetts. Complaints of a loss of half of the area planted have been frequent, the kernels being entirely consumed by the wireworms, and in a number of cases as many as fifteen to twenty of these larvæ have been found at work close to a single seed.

An opportunity for coöperation in experiments for the control of this pest was therefore taken advantage of, and a series of tests now extending through two seasons have been made.

Crows have been a factor to consider in addition to the wireworms and were taken into consideration, but one treatment, which as far as the writer knows has never before been made use of, has proved effective for both kinds of pests, and may, in the opinion of the writer, be considered as fairly well established, if the entire success of every test made during 1908 and 1909 be regarded as sufficiently extended.

In brief the treatment consists of tarring the seed as is often done to keep crows from feeding upon it. The seed was then placed in a bucket containing fine dust and Paris green mixed in such proportions that the corn, after being shaken up in the bucket, showed a greenish color. The corn thus treated fed properly through the seeder and in every case came up satisfactorily, while check rows were badly injured. Examination of some of the corn thus treated, after about a week, showed that the wireworms were present close by the seed but that they did not molest the seed itself, apparently being repelled rather than destroyed by the treatment. It was evident that the germination of the seed was not affected, and it is probable that the Paris green was present in sufficient quantity to prove a fatal dose for crows which might attack it.

Soaking the seed in strychnine and other poisons gave far less satisfactory results than the one just given.

Further experiments may perhaps develop defects in this method, but none have as yet appeared, and it seems desirable to test it on a large scale in different parts of the country.

FUMIGATION, DOSAGE AND TIME OF EXPOSURE

By J. L. Phillips, *Blacksburg, Va.*

The fumigation of nursery stock was begun in this state under the direction of Mr. W. B. Alwood in the fall of 1896, and soon came into general use in the Virginia nurseries. The fear of San Jose scale was felt very strongly during the first years of this work, and if nurserymen noticed injury from the use of this gas, our attention was not called to it. In fact, a number of nurserymen left their nursery stock exposed to the gas from 8 to 10 hours without noticing any ill effect.

A number of lots of nursery stock, infested with San Jóse scale, were fumigated during these early years and examined the following summer without finding any living San Jose scale, and nurserymen and entomologists alike appear to have settled down to the conclusion that fumigation is effective, and that no injury need be expected if dormant nursery stock is fumigated according to directions usually given.

Of course every one recognizes the fact that for fumigation to be effective it must be conducted under the supervision of careful, intelligent men, who will carry out the directions in detail. Human

nature is very much the same the world over, and it requires some determination for the nurseryman in the height of the shipping season to demand that his workmen leave the fumigation house closed from 40 minutes to 1 hour, when he needs the stock to fill a number of orders, or to go through the fumigation process twice when he is quite sure the full amount of stock he has on hand can be crammed into the house at one time.

It is not surprising then that instances have come to our attention where stock that had been fumigated and set in orchards, remote from known cases of infestation with San Jose scale, develop this trouble. The fact that a large amount of adulterated potassium cyanide was on the market at that time also added to the difficulties.

Reports also began to reach us during 1903 and 1904 in regard to injury from fumigation. While we were sure, in the light of our experience in fumigation work, that some other agency was responsible for the trouble, careful tests were made during the fall of 1904, from which the conclusion was reached that nursery stock should not be injured by fumigation, as ordinarily recommended. In fact, no permanent injury to dormant trees treated with from 3 to 4 times the normal strength of gas was observed. Injury was noted in case of stone fruits, especially cherry, fumigated with the regular charge late in the spring after growth had started up. Messrs. Symons of Maryland and Burgess of Ohio carried out similar experiments about the same time with similar results.

The writer also had a large number of samples of cyanide on the market in the state during 1904 and 1905 analyzed, and found much of it to be impure. The close packing of nursery stock in the fumigation house, however, appeared to be one of the main sources of trouble. The writer's experiments on this phase of the question indicated that one could not expect fumigation to be effective against the San Jose scale on plants in the far corner of the fumigation house with an exposure of 40 minutes to this gas, even with ordinary 2 year apple stock if it is packed tightly. It also seemed impractical either to increase the charge or length of exposure to the gas sufficiently to fully compensate for the error of packing stock too tightly in the house.

Mr. Symons[1] found in his recent experiments: "That .30 grams with 30 minutes' exposure is hardly sufficient for fumigating trees known to be infested with San Jose scale (a little greater than ordinarily recommended) and that with this strength a 45 minute ex-

[1]See bulletin 131, Md. Agr. Exp. Sta., College Park, Md.

posure should be made in order that the gas may be considered a fairly sure preventive." He also reached the conclusion:

"In fumigating nursery trees at the normal recommended strength, viz, 1 ounce of cyanide to 100 cu. ft., the duration of exposure should be 1 hour, and if less time is desired the strength of the gas may be increased with perfect safety to the trees, and insure as far as possible the killing of any scale that may be present."

While we had concluded from our various experiments and observations that a 60 minute exposure is preferable to a shorter length of time in ordinary nursery work, it was decided to call attention to these facts in a circular letter to state nursery inspectors, and request from them an opinion in regard to the length of exposure. Replies were received from 29 inspectors, practically all of whom expressed the opinion that a 45 minute exposure to the ordinary strength of gas is sufficient to kill the San Jose scale under best conditions of exposure, etc. All appeared to agree also on the point that no injury need be expected to dormant nursery stock even though exposed to the gas for a much greater period.

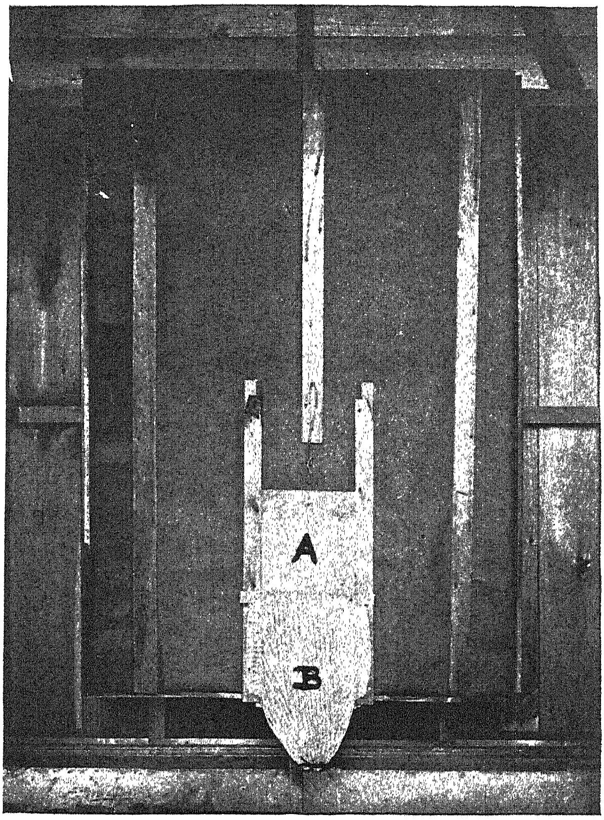
Mr. J. A. West of Illinois called attention to injury from fumigating cherry stock both in the fall and spring. Mr. Berger states that 45 minutes' exposure to a dose of 1 ounce is injurious to citrous nursery trees, but that the trees will stand this strength of gas if the roots are covered, so as to protect them from the gas.

Of the 29 entomologists replying to the above circular, one is recommending a 30 minute exposure, twelve a 40 minute exposure, four a 45 minute exposure, two a 50 minute exposure, and five a 60 minute exposure. Several did not express themselves in letter of reply, while nine who are recommending a less exposure, stated they had about decided to recommend a 60 minute exposure, or inclined strongly towards this recommendation.

At a meeting of the American Association of Horticultural Inspectators, held in Washington, D. C. November, 1903, the 1-2-4 formula was adopted and has now come into use generally. There appears, however, to have been a lack of any very definite experiments as to the chemical combination of the materials used in generating this gas, upon which to base this recommendation.

Recent work by Mr. R. S. Woglum, of the Bureau of Entomology,[2] in conjunction with the Bureau of Chemistry, appears to throw some light on the subject. From these experiments, it seems that 2 parts of water to 1 part each of acid and cyanide produces the maximum

[2]See bulletin No. 79, Bureau of Entomology, U. S. Dept. Agr.



A, sliding door, and B, sleeve over opening to box.
PLATE 18.—Fumigation box seen from inside workroom.

amount of gas, but in this case the residue in the jar frequently congeals within 1 hour. It is stated however, that by using 3 parts of water the residue in the jar seldom congeals. It was found also that the greater the proportion of water used, (in addition to the maximum mentioned above) the smaller the quantity of gas evolved, until with 8 parts of water to one each of acid and cyanide less than 50 per cent. of the hydrocyanic acid passed off as gas.

As there now seems to be some definite experimental data to support the 1–1–3 formula, there appears to be no valid reason for not adopting it generally, and thus making the recommendation uniform. We prefer to state the formula in the order in which the chemicals are added, hence the change in position in the following:

Water..3 fluid oz.
Commercial sulphuric acid (high grade 66 Beaume or 1.83 Sp. Gr.)..1 fluid oz.
Fused potassium cyanide, 98%.......................................1 oz.

To each 100 cubic feet of air space in the fumigating room.

The charge should remain in the room for one hour.

NURSERY INSPECTION IN LOUISIANA

By Arthur H. Rosenfeld, *Assistant Entomologist, State Crop Pest Commission of Louisiana, Baton Rouge*

Nursery conditions in the Pelican State might be described as both temperate and semi-tropical in character. The nurseries in the northern portion of the state grow such stock as apple, peach, plum, hardy hedge and ornamental plants, etc., while the majority of the nurseries in southern Louisiana grow such plants as orange, lemon, kumquat, *Ficus,* cape jasmine, pecan, etc. The insects attacking these two classes of nursery plants are quite distinct, but, as it is presumed that this discussion was intended to bring out a comparison of the methods in vogue in the various states, the writer will confine his description of inspection methods to those nurseries in which deciduous stock is grown.

Our inspections in these nurseries are made for the usual insects and plant diseases, with San José scale, of course, the principal *bête noire.* On account of our long, hot summer, nursery inspection is not begun until after July 1, as we have found that nurseries inspected earlier than this and found apparently free of infestation may, by September or October, show a comparatively heavy infestation.

The regulations of the State Crop Pest Commission require the inspection, at least once each season, of all nurseries doing business in

the state, this inspection being made without cost to the nurseryman if application for inspection is made prior to July 1. To date (July 7) sixty-seven nurserymen have requested inspection. Last season eighty-five certificates of inspection were issued, valid until September 1. We have thought best to extend the date of expiration of certificate to September 1, as a number of our pecan growers desire to ship budding wood in July and August, and, where the certificates expire July 1, they are often inconvenienced in doing so.

Another departure we have made recently from our usual course is to exempt from inspection growers of strawberry plants who sell to local trade only. We require only those growers who ship by rail or steamboat to have inspection, thus doing away with the inspection of dozens of places from which plants would be sold only to immediate neighbors. In a strawberry section like one of our main trucking regions practically every planter in the entire section will grow berries, and, if he has any surplus plants, will dispose of them to some of his neighbors. Hence our inspectors would be constantly receiving requests to inspect places from which plants would be sold, or given away, to near neighbors only. Our present method of handling these cases has greatly simplified matters.

The condition mentioned in Mr. Washburn's recent article,* regarding the difficulty of determining just what constitutes a nurseryman, arises, of course, in every state. Where a nurseryman grows just a little stock and is, in reality, a dealer, we inspect all heeling-in grounds thoroughly, and require him to file with us a list of all nurseries from which he will purchase. A certificate is then issued to him, if his place is found in proper condition and the nurseries from which he will purchase are considered up to standard, and file with us copies of their certificates of inspection. We have had very little trouble with these dealers attaching their tags to any but stock of which we have authentic knowledge.

Now as to the actual method of inspection. On account of our rather small number of nurseries we are enabled to carry out the inspection very thoroughly, and it is by no means unusual for one or two inspectors to spend from a month to six weeks in the larger of our nurseries. Naturally, if scale is brought into a nursery, it is going to come in on some of the propagating wood, and several trees of one variety which are infested are more than likely to show infestation. Hence our inspectors are instructed to inspect at right angles to the rows, crossing and re-crossing at intervals of from 12 to 15 feet, inspecting two or three trees in each row as they cross.

*Jour. Econ. Ent. Vol. II, p. 246.

In this way every variety is pretty thoroughly examined, and when any San José scale is found a tree-to-tree inspection is made of that entire variety or block. An outline of the course pursued when San José scale was found in small numbers in one of our large nurseries last season will illustrate our usual method of handling infestation.

In the first place, all centers of infestation were located carefully, and the trees within about twenty feet in every direction cut down and burned. These infestations were located by making a tree-to-tree inspection of each block in which any scale at all had been detected. About six weeks after the first inspection these blocks were again given a tree-to-tree inspection, and all infested and adjoining trees burned. Then, when shipping time arrived, the nurserymen were instructed to fumigate everything sent out, and one of our inspectors detailed to superintend the entire fumigation. The nurserymen were requested to do all digging at as nearly one time as possible, in order that our inspector would not have to spend too long a time at one place. The trees were examined by our inspector as they went into the fumigating house (built according to our directions), and any infested trees found thrown out. Fumigation with 98 per cent. KCN and C. P. sulphuric acid was insisted upon. In this manner we believe that the interests of those purchasing these trees are as thoroughly protected as is possible.

In addition to the regular inspection of nurseries our inspectors are instructed to inspect all orchards or susceptible trees within three quarters of a mile of a nursery, and where such places are found infested proper treatment is enforced.

All inspections are made by the entomologist of the State Crop Pest Commission or by his regular assistant entomologists.

Nurserymen are required to throw out all trees infested with woolly aphis, nematode root knot, crown gall, hairy root disease, etc.

Through the kindness of Dr. L. O. Howard and the chief of the Bureau of Horticulture of the New York Department of Agriculture, we have been kept notified of all foreign shipments to this state *via* the Port of New York, by which way most of our foreign shipments arrive. Most of these shipments are of bay trees (*Laurus nobilis*) and some other ornamental plants from Belgium to the New Orleans florists, and, although we have examined several thousand such plants, no trace of gypsy or brown-tail moths has been discovered. We have sent out circular letters to the nurserymen, requesting notification of the placing of all orders for foreign plants, and they have been very prompt in responding.

ADDITIONAL REARINGS IN CECIDOMYIIDAE

By E. P. Felt, *Albany, N. Y.*

The rearings of the last few months have assisted materially in clearing up certain puzzles, and have done much to support our belief in the taxonomic value of characters employed for the separation of sub-families, tribes, genera and species in this group. The numerous species of Cincticornia reared from galls on oak leaves force us to the conclusion that this genus is practically restricted to Quercus, while the many forms of Caryomyia (a new genus erected, with *Cecidomyia tubicola* O. S. as type) obtained from galls on hickory leaves compel us to believe that this group is peculiar to Carya. Furthermore, our rearings establish beyond all question the validity of the recently proposed genus Sackenomyia, erected for a single female, and enabled us to define not only both sexes but larvæ and pupæ, and to ascertain the life histories of two forms. The following brief characterizations of the additional species reared and the galls they were obtained from will suffice till more extended descriptions can be published.

Baldratia vesiculosa n. sp. was reared September 24, 1908, from scattered, oval, green swellings, 2 mm. long, on the under side of a blue-flowered aster leaf. The male is 1.75 mm. long, with unicolorous tarsi; the abdomen mostly deep orange, segments 1 to 5 being sparsely clothed with dark brown scales and narrowly margined with a few white scales. Antennal segments, 14; palpi, uniarticulate. Female 2 mm. long, with 15 antennal segments and a dark brown abdomen, with submedian silvery spots. Type Cecid. a1884.

Baldratia dumosæ n. sp. was reared July 30, 1908, from an inconspicuous yellowish brown blister gall taken by Miss Cora H. Clarke at Annisquam, Cape Ann, Mass. Female 1.75 mm. long, with unicolorous legs, and the dark brown abdominal segments narrowly margined with white. Antennal segments, 13; palpi, uniarticulate. Type Cecid. a1870a.

Baldratia waldorfi n. sp. was reared in early May, 1908, from a brown blister gall some 3 mm. in diameter, on the leaf of an unknown hairy aster. Male 2 mm. long, the legs unicolorous and the dark brown abdominal segments narrowly margined. The female with 18 and the male with 16 antennal segments, the palpi biarticulate. Type Cecid. a1824.

Baldratia nitida n. sp. was reared April 17, 1908, from a yellowish, smooth blister gall 6 to 7 mm. in diameter, on the basal leaves of aster.

Female 2 mm. long, legs unicolorous, the dark brown abdominal segments narrowly margined with white. Antennæ with 21 segments; palpi biarticulate. Type Cecid. a1820.

Lasioptera clarkei n. sp. was reared January 18, 1909, from whitish, circular blister galls, some 2 to 3 mm. in diameter, on aster, taken by Miss Cora H. Clarke at Magnolia, Mass. Male 2 mm. long, the dark brown abdomen unicolorous. Antennæ fuscous yellowish, with fifteen segments, the fifth with a length one fourth greater than its diameter; female with 18 antennal segments. Type Cecid. a1901.

Lasioptera riparia n. sp. was reared April 27, 1908, from an oval or fusiform petiole or tendril gall, 1.5 mm. long, on *Vitis bicolor,* taken at Westfield, N. Y. Male 1.75 mm. long. Abdomen with the four basal segments mostly yellowish, the mesonotum shining dark brown. Antennæ with 20 segments, the 5th with a length slightly greater than its diameter. Type Cecid. a1784a.

Lasioptera danthoniæ n. sp. was reared by C. R. Crosby of Ithaca from Danthonia, taken at White Church, N. Y. Male 1.5 mm. long. Abdomen dark brown, the basal segment white, the second to fourth with submedian white spots. Antennæ with 16 segments, the fifth with a length three fourths its diameter. Type Cecid. a1925.

Lasioptera galeopsidis n. sp. was reared in June, 1900, from irregular stem galls on *Galeopsis tetrahit,* taken by Miss Cora H. Clarke at Boston, Mass. Male 1.5 mm. long. Abdomen dark brown, segments 1 to 5, with submedian white spots. Antennæ with 16 segments, the fifth with a length one fourth greater than its diameter. Female 2.5 mm. long. Antennæ with 23 segments, the fifth with a length three fourths its diameter. Type Cecid. a1965.

Lasioptera virginica n. sp. was reared February 9, 1909, from an irregular stem gall, on marsh St. Johnswort, taken by Miss Cora H. Clarke at Magnolia, Mass. Female 2 mm. long. Abdomen black, the segments with submedian white spots. Antennæ with 18 or 19 segments, the fifth with a length three fourths its diameter. Type Cecid. a1915.

Lasioptera spirææfolia n. sp. was reared July 16, 1909, from a yellowish, brown-spotted, circular blister gall, 3 mm. in diameter, on *Spiræa salicifolia* leaves, taken by Miss Cora H. Clarke at Magnolia, Mass. Male .75 mm. long, the body mostly yellowish. Antennæ dark brown, yellowish basally; 14 segments, the fifth with a length one half greater than its diameter. Type Cecid. a1860.

Lasioptera cassiæ n. sp. was reared May 6 and June 16, 1883, from irregular stem galls, 5–6 mm. long, on the sensitive plant, *Cassia nictitans,* taken by H. K. Morrison at Fort Huachua, Ariz., and placed at

our disposal through the courtesy of Doctor Howard. Male 1.5 mm. long. Abdomen dark reddish brown, the segments narrowly margined with white; antennæ with 19 segments, the fifth with a length equal to its diameter. Female 2 mm. long; antennæ with 23 to 24 segments, the fifth with a length three fourths its diameter. Type Cecid. 901.

Lasioptera murtfeldtiana n. sp. was reared September 9, 1896, from sunflower seeds taken at Kirkwood, Mo., probably by Miss Murtfeldt. The specimens were placed at our disposal through the courtesy of Doctor Howard. Male 2 mm. long; abdomen yellowish brown, the third vein uniting with costa at the distal third; legs unicolorous; antennæ with 17 segments, the fifth with a length three fourths its diameter. Type Cecid. 902.

Neolasioptera menthæ n. sp. was reared by Mr. L. H. Weld May 13 and 19 from a polythalamous mint stem gall, 6–12 mm. long, taken in the vicinity of Chicago, Ill. Male 1.5 mm. long; abdomen dark brown, the segments broadly margined posteriorly with white, those of the second to seventh broadly interrupted mesially; legs narrowly annulate with white; antennæ with 17 segments, the fifth with a length nearly equal to its diameter. Female 2.75 mm. long; abdomen dark brown, with submedian silvery spots and laterally subtriangular, white marks on segments 1 to 6; antennæ with 25 segments, the fifth with a length three fourths its diameter. Type Cecid. a1823.

Neolasioptera ambrosiæ n. sp. was reared by Mr. C. R. Crosby in January, 1909, from the stems of giant ragweed, *Ambrosia trifida*, taken at Ithaca, N. Y. Male 2 mm. long. Abdomen dark brown, with white submedian spots. Antennæ with 15 segments, the fifth with a length one fourth greater than its diameter; female 2.25 mm. long, with 17 or 18 antennal segments. Type Cecid. a1926.

Dasyneura maritima n. sp. was reared in April, 1909, from the tightly rolled terminal leaflets of the beach pea, *Lathyrus maritimus*, taken by Miss Cora H. Clarke at Magnolia, Mass. Male 1.75 mm. long. Abdomen dark brown. Antennæ with 18 segments, the fifth with a stem three fourths the length of the basal enlargement, which latter has a length one half greater than its diameter. Female 2 mm. long, with 16 to 17 antennal segments, the fifth with a length twice its diameter. Type Cecid. a1895.

Dasyneura gemmæ n. sp. was reared in late March and early April, 1909, from small conic apical bud galls on willow taken by Mr. C. P. Smith at Logan, Utah. Male 2 mm. long. Abdomen dark brown. Antennæ with 18 segments, the fifth with a stem one fourth longer than the cylindric basal enlargement. Female 2.5 mm. long. An-

tennæ with 16 segments, the fifth with a length two and one half times its diameter. Type Cecid. a1937a.

Dasyneura radifolii n. sp. was reared April 16–20, 1909, from an irregular, oval gall composed of root leaves of *Solidago puberula* or *S. juncea* taken by Miss Cora H. Clarke at Magnolia, Mass. Male 1.5 mm. long. Abdomen dark reddish brown. Antennæ with 17 segments, the fifth with a stem one fourth longer than the basal enlargement, which latter has a length two and one half times its diameter. Female 2 mm. long, with 16 antennal segments, the fifth with a length two and one half times its diameter. Type Cecid. a1911.

Dasyneura corticis n. sp. was reared by Miss Cora H. Clarke May 21, 1909, from small willow twigs taken in the Arnold arboretum at Boston, Mass. Male 2 mm. long. Abdomen dull reddish orange. Antennæ with probably 16 segments, the fifth with a stem three fourths the length of the cylindric basal enlargement, which latter has a length twice its diameter. Female 1.75 mm. long. Abdomen deep red. Antennæ with 15 segments, the fifth with a length two and one half times its diameter. Type Cecid. a1966.

Dasyneura toweri n. sp. was reared September 16 and October 20, 1908, from enlarged flower buds of *Hypericum mutilum* taken by Miss Cora H. Clarke at Magnolia, Mass. Male 2.5 mm. long. Abdomen a variable reddish. Antennæ with 19 segments, the third with a stem one fourth longer than the cylindric basal enlargement, which latter has a length twice its diameter. Female 2 mm. long, with 19 antennal segments, the fifth with a length three times its diameter. Type Cecid. a1883.

Dasyneura aromaticæ n. sp. was reared by Miss Cora H. Clarke August 23, 1908, from an ovoid, hairy, green, axillary or terminal gall, about 4 mm. in diameter, on mint taken at Barre, Mass. Male 1.25 mm. long; abdomen yellowish brown, the basal segments and genitalia fuscous; antennæ with 14 segments, the fifth with a stem as long as the basal enlargement, which latter has a length one half greater than its diameter, the third and fourth palpal segments equal. Type Cecid. a1875.

Rhabdophaga elymi n. sp. was reared January 19, 1891, from *Elymus americanus* collected at Alameda, Cal. Female 2 mm. long. Abdomen light reddish brown. Antennæ with 16 segments, the fifth with a length at least three times its diameter, the fourth palpal segment a little longer than the third. Ovipositor stout, about one fourth the length of the abdomen, the lobes broadly oval and with a length one fourth greater than the width. Type Cecid. 1044.

Rhabdophaga rileyana n. sp. was reared by the late C. V. Riley in

June and July, 1877, from a crumpled soft maple leaf. Female 1.25 mm. long. Abdomen yellowish brown. Antennæ with 15 segments, the fifth with a length twice its diameter, the fifteenth reduced, partly fused with the fourteenth, the fourth palpal segment twice the length of the third. Ovipositor about one half the length of the abdomen. Type Cecid. 1041.

Rhabdophaga latebrosa n. sp. was reared May 7, 1909, presumably from apparently normal willow buds. Male 1.5 mm. long. Abdomen yellowish brown. Wings broad, with a length only about one half greater than the width, antennal segments 17, the fifth with a stem three fourths the length of the basal enlargement, which latter has a length two and one half times its diameter, the fourth palpal segment one half longer than the third. Type Cecid. a1958.

Rhabdophaga caulicola n. sp. was reared in April, 1908, from slender willow twigs, similar to those producing *Sackenomyia packardi*, and collected by Mr. L. H. Weld at Evanston, Ill. Male 2 mm. long. Abdomen dark reddish brown. Antennæ with 18 or 19 segments, the fifth with a stem three fourths the length of the basal enlargement, which latter has a length twice its diameter; ventral plate long, deeply and roundly emarginate. Female 3.25 mm. long. Abdomen reddish brown. Antennal segments 18, the fifth with a length two and one half times its diameter, the fourth palpal segment a little longer than the third. Type Cecid. a1822.

Rhabdophaga hirticornis n. sp. was reared in September, 1908, and April, 1909, from jars containing *Caryomyia persicoides* galls and those of *Schizomyia pomum*, the Rhabdophaga probably coming from the debris. Male 2 mm. long. Abdomen dark brown. Antennal segments 18, the fifth with a stem three fourths the length of the basal enlargement, the ventral plate broad, deeply and roundly emarginate. Female 2.25 mm. long. Antennal segments 19, the fifth with a length one half greater than its diameter, the fourth palpal segment longer than the third. Type Cecid a1941.

Sackenomyia viburnifolia n. sp. was reared in numbers the latter part of April, 1909, from purplish fusiform vein swellings 5 mm. long, on arrow-wood, *Viburnum dentatum*, taken at Magnolia, Mass., by Miss Cora H. Clarke. Male 1 mm. long; body nearly uniform pale yellow. Antennæ with 14 segments, the fifth with a stem as long as the cylindric basal enlargement. Female 1.5 mm. long. Antennæ with 13 or 14 segments, the fifth with a length one half greater than its diameter. Type Cecid. a1896.

Sackenomyia packardi n. sp. was reared April 15 and 16, 1909, from irregularly swollen twigs of willow taken by Winthrop Packard at

Canton, Mass. Male 2.75 mm. long. Abdomen dark red. Antennæ with 22 segments, the fifth with a stem one fourth the length of the cylindric basal enlargement. Female 3.5 mm. long. Abdomen mostly deep red, 21 subsessile segments. The deep orange larva is unique, with the breastbone dilated anteriorly and multidentate. This species is closely related to *Sackenomyia* (*Cecidomyia*) *porteræ* Ckll., though readily separated therefrom. Type Cecid. a1934.

Rhopalomyia castaneæ n. sp. was reared June 13, 1908, from a gall on chestnut, the leaf petiole being affected and frequently embracing the entire tip of the twig and causing a deformity like brussels sprouts. This gall was taken by the writer at Stowe, Mass. Female 1.75 mm. long. Abdomen a deep fuscous orange. Antennæ with 12 segments, the fifth with a length one fourth greater than its diameter. Type Cecid. a1716.

Cincticornia pustulata n. sp. was reared in April and May, 1909, from oval, pustulate swellings, 5 to 6 mm. in diameter, on the leaves of yellow barked or black oak, *Quercus velutina*, taken by Miss Cora H. Clarke at Magnolia, Mass. Male 2 mm. long. Abdomen deep reddish orange; scutellum fuscous yellowish; wings small and relatively long and narrow; fifth antennal segment with 8 to 9 circumfili. Female, abdomen mostly dark reddish orange, the fifth antennal segment with a length four times its diameter and with four anastomosing circumfili. Type Cecid. a1789.

Cincticornia simpla n. sp. was reared in April and May, 1909, from an irregularly oval, pustulate swelling, 5 to 6 mm. in diameter, from the leaves of the yellow barked or black oak, *Quercus velutina*, and also red oak, *Q. rubra*, taken by Miss Cora H. Clarke at Magnolia, Mass., and also collected in the vicinity of Albany. Male 2 mm. long. Abdomen dark brown; scutellum reddish brown; wings small, relatively short and broad; fifth antennal segment with a length two and one half times its diameter and but two stout circumfili. Female, abdomen mostly deep reddish orange, the fifth antennal segment with a length three and one half times its diameter. Type Cecid. a1942.

Cincticornia globosa n. sp. was reared in April and May, 1909, from a subhemispheric, brown, slightly nippled oak leaf gall, 1.75 mm. in diameter. Male 2 mm. long. Abdomen dark brown; scutellum reddish brown; wings small, relatively short and broad; fifth antennal segment with a length about three times its diameter and 11 circumfili. Female abdomen reddish orange, the fifth antennal segment with a length four times its diameter and 4 anastomosing circumfili. Type Cecid. a1902.

Cincticornia podagræ n. sp. was reared in April, 1908, from a nar-

row, dark purplish, fusiform vein swelling, 8 mm. long, on the under side of oak leaves. Male 2 mm. long. Abdomen a variable reddish or dark brown; scutellum dark brown; wings small, relatively short and broad; fifth antennal segment with a length nearly four times its diameter and 7 or 8 circumfili. Female 2.5 mm. long. Abdomen mostly dark brown, the fifth antennal segment with a length four times its diameter and four anastomosing circumfili. Type Cecid. a1788.

Caryomyia[1] *antennata* n. sp. was reared in the spring of 1909 from a yellowish green or brown, subglobular, thick-walled hickory leaf gall, 4 to 5 mm. in diameter. Male 3 mm. long. Abdomen deep reddish orange, the fifth antennal segment binodose, the nodes separated by distinct stems; dorsal plate broad, narrowly emarginate, the lobes rounded. Female 4 mm. long, the fifth antennal segment with a length three and one half times its diameter, the larval breastbone unidentate. Type Cecid. a1944.

Caryomyia consobrina n. sp. was reared in April and May, 1909, from a small, depressed, globular, yellowish green or brownish, thin-walled hickory leaf gall 2 mm. in diameter. Male 2 mm. long. Abdomen fuscous yellowish; fifth antennal segment binodose, the nodes separated by distinct stems; ventral plate broadly and roundly emarginate. Female 3 mm. long. Abdomen brownish orange, the fifth antennal segment with a length three and one half times its diameter, larval breastbone unidentate. Type Cecid. a1948.

Caryomyia similis n. sp. was reared the latter part of April and early in May from a thin-walled, subglobular, slightly nippled hickory leaf gall 2 to 3 mm. in diameter. Male 1.75 mm. long. Abdomen reddish orange; wings short and broad; fifth antennal segment cylindric, with a length twice its diameter. Female 2.75 mm. long, the fifth antennal segment with a length three and one half times its diameter, the larval breastbone unidentate. Type Cecid. a1946.

Caryomyia inanis n. sp. was reared April 29, 1909, from an irregular, subglobular, thin-walled hickory leaf gall, 2 to 3 mm. in diameter, and easily recognized by the more or less complete false chamber at the tip of the gall. Female 3 mm. long. Abdomen deep

[1]Caryomyia n. g. This genus is allied to Hormomyia, but differs therefrom by the thorax not being greatly produced over the head. There are never more than 14 antennal segments. The flagellate antennal segments of the male are invariably ornamented with three low, stout circumfili and may be binodose. Those of the female are cylindric and provided with but two circumfili. The wings are relatively broad, the third vein uniting with the margin at or near the apex. Type *Cecidomyia tubicola* O. S. There is but one generation annually, the adults issuing direct from the galls.

red; wings relatively large and broad; fifth antennal segment with a length two and one half times its diameter. Type Cecid. a1950.

Caryomia caryæ O. S., *C. holotricha* O. S., *C. sanguinolenta* O. S., and *C. tubicola* O. S., all formerly referred to Cecidomyia and later to Hormomyia, have also been reared and described.

Clinodiplosis caryæ Felt was first taken on hickory June 19, 1906, and subsequently reared from a hickory leaf gall by the late Dr. M. T. Thompson of Worcester, Mass., and last spring was obtained in this office from two different hickory leaf galls. This species is probably an inquiline in hickory galls produced by several species of Caryomyia.

Clinodiplosis spiræ n. sp. was reared in July and August, 1909, from a variable yellowish or reddish marginal roll on young leaves of *Spiræa salicifolia* taken by Miss Cora H. Clarke at Magnolia, Mass. Male 1 mm. long; abdomen yellowish, with its extremities deep orange; ventral plate long, narrowly rounded; fifth antennal segment with the stems respectively two and two and one half times their diameter. Type Cecid. a1838.

NOTES ON ADDITIONAL INSECTS ON CULTIVATED PECANS

By Glenn W. Herrick, and R. W. Harned

The senior author has been working for a number of years on insects affecting pecans, and since the publication of Bulletin 96 on Insects Injurious to Pecans by the Mississippi Experiment Station, the following insects have been noted as occurring on pecan trees and causing more or less injury.

Acordulecera maura MacG.

We have found numbers of these sawfly larvæ on the leaves of pecan trees at Agricultural College, Mississippi. They have a curious and interesting method of feeding. They are gregarious and feed on the leaflets in ranks or rows along the margins, with their bodies at right angles to the edges of the leaflets and their heads all pointing outward. They line up along the edge of a leaf in this position, quite as regular as a line of soldiers. They do not invariably assume this regular position in feeding and are sometimes found feeding irregularly over the leaves.

Fortunately these larvæ did not occur in sufficient numbers to produce serious injury, but it is quite possible they may do so. So far as we know, these sawflies constitute a new pest to pecan trees, al-

though Doctor Chittenden writes that he found some sawfly larvæ working on pecan trees in Maryland, but does not say what species they were.

In our attempt to breed these larvæ we hurriedly placed them on leaves, the stems of which were kept in a tumbler of water, the whole being placed on a table under a glass cylinder without any earth. They, therefore, had no opportunity to enter the earth to pupate, had they so desired.

They spun their cocoons at the bases of the leaves among the cotton and among the debris that had accumulated on the table, and a few spun cocoons here and there among the leaves.

We were both absent from the college for a day at this time and found on our return that all the cocoons had been spun in our absence, May 6.

On May 11 adults appeared, which we sent to Doctor McGillivray for identification. In a letter of June 8 he informed us that they belonged to the species *Acordulecera maura* MacG., which he had just described in the Can. Ent., Vol. XL, May, 1908, p. 168. He there records this species from North Mt., Penn., Ames, Iowa, and Ithaca, New York.

From our observations on this insect, we conclude that it might become of some economic importance if it ever happened to occur abundantly. We believe, however, it could be easily controlled by the use of arsenate of lead.

Sawfly No. 2

During the month of April, 1908, we found many rather large sawfly larvæ on the leaves of pecan trees. These also have a very interesting method of feeding and quite distinctive from the foregoing species. The larvæ feed separately and, for the most part, begin at the top of a leaflet and eat it clean on both sides of the midrib as far as they go. Whenever one of them desists from eating and assumes a resting attitude, it always curls or coils tightly about the naked midrib (or petioles), to which it tenaciously clings. Occasionally one begins in the middle of a leaflet and eats out a hole on both sides of the midrib, always, however, lying closely curled about the midvein when at rest. This attitude seems characteristic, although I am not widely familiar with sawfly larvæ and their habits. Although we observed these larvæ carefully during their life history and made descriptions of the different stages and molts, yet we make no record of them here because we believe there were two species among the larvæ

observed and some confusion exists in our minds regarding the differentiation of the two.

They pupated during June.

Aulacaspis pentagona Targ.

We are not aware that this coccid has ever been recorded as occurring on the pecan. We found it in considerable numbers on the branches of pecan in Natchez, Mississippi, in the yard of a gentleman where this insect was quite abundant on peach trees. It was associated with the next species.

Chrysomphalus obscurus Comst.

We also found this species occurring in great abundance on the branches of pecans growing in the same yard. This coccid has been reported on hickory, but we can find no record of it on pecan.

Phylloxera caryaecaulis Fitch.

We have had reports and specimens of this pest on pecans from several correspondents in Mississippi. On May 22, 1908, we received from a correspondent some pecan branches which were literally covered with the galls of the insect. Mr. Sherard, the correspondent, said "they covered every twig on the tree like the sample sent. I noticed them on others in the same vicinity. Can you tell me whether or not there is any danger of their killing or injuring my trees? They seem to be retarding this year's growth."

The petioles and young twigs sent to me were covered with galls, large and small. The galls opened by several valves, usually four, like a Geaster puff ball. The specimens were submited for identification to Doctor Pergande, through the kindness of Dr. L. O. Howard.

Mr. Pergande gives a description of this insect and its stages in his monograph of the North American Phylloxerinæ, p. 244. We hope to get opportunity to study all of these species farther and in more detail, together with other pecan pests of which we have only fragmentary notes at present.

Aspidiotus perniciosus Comst.

We found this notorious pest occurring quite abundantly on pecan trees at Scranton and Stinson, Miss. It was mainly confined to the petioles of the leaves but was also present on the bark.

All the affected trees were near badly infested orchards of plum and peach trees.

A PRELIMINARY LIST OF THE COCCIDAE OF WISCONSIN

By Harry C. Severin and Henry H. P. Severin, *941 Grove St., Milwaukee, Wis.*

Very little has been done on the Coccidæ of Wisconsin, and, with the exception of the nursery and orchard inspector's reports, scarcely any references are to be found in literature on this important economic group of insects occurring in this state. The following list of scale insects is not intended as a complete enumeration of the Coccidæ to be found in Wisconsin, but is presented simply as a preliminary to the study of this fauna. All of the species listed were, with one exception, collected by the writers during the year 1908 in Milwaukee County. We have omitted the Eulecaniums in this paper, preferring to delay the publication of the species belonging to this genus, which we have collected, until Mr. J. G. Sanders, who is revising the genus, may have completed his work.

It is the plan of the writers to publish later an illustrated manual with keys and descriptions for the species to be found in Wisconsin. It is hoped that this paper may interest collectors in various parts of the state, without whose assistance this work can progress but slowly. Any assistance in the way of specimens occurring in the state will be thankfully received and proper credit will be given to the collectors.

Little trouble need be experienced in collecting or preparing scale insects to be sent through the mails. As a rule the out-of-door Coccidæ are to be found chiefly on the smaller twigs and branches of shrubs and trees in this region; yet some may be found on the leaves of trees, as on the evergreens, on the roots of plants or in the nests of ants. The indoor scale insects, or the scale insects which infest our conservatories, have been introduced into this state from warmer climates and may be found not only on all parts of trees and shrubs but upon herbaceous plants as well. As a general rule it is best to gather portions of an infested plant with the insects *in situ* and to preserve these in the dry condition. At times, however, as with the softer species of Coccids, alcoholic material is often useful, but even in such instances it should always be supplemented with dry specimens. It cannot be too strongly urged that when possible, plenty of material should always be taken. For, while the better known species can usually be recognized from an examination of the superficial characters of a few specimens or even of a single scale, less known species or new species require quite a number of specimens,

so that they may be properly studied. Small card boxes, or if these are not to be had, large envelopes are generally used to send scale insects through the mails. With the insects there should always be enclosed, when possible, the following information: locality in which the insects were collected, date of collection, name of food plant, name of collector, extent of injury to the plant, and any other remarks that may seem desirable.

We are indebted to Dr. C. L. Marlatt for verifications of species and to Prof. Herbert Osborn for literature used from his excellent library on Coccidæ.

1. *Kermes andrei* King, on oak, July 29, 1908.
2. *Kermes pubescens* Bogue, on oak, July 29, 1908.
3. **Pseudococcus citri* (Risso), common in greenhouses.
4. **Pseudococcus longispinus* (Targ.), common in greenhouses.
5. *Pulvinaria vitis* (Linn.), common and often injuriously abundant on maples; also on grape, linden, lilac and willow.
6. **Eucalymnatus perforatus* (Newst.), on palm and seaside grape.
7. **Coccus hesperidum* (Linn.), on banana and century plant.
8. **Coccus longulus* (Dougl.), on Acacia, Ficus lancelota and mimosa.
9. **Saissetia hemisphærica* (Targ.), on croton, ferns, oleander and many other greenhouse plants.
10. **Saissetia oleæ* (Bern.) on oleander and fig.
11. *Chionaspis americana* Johns., on Ulmus americana, August 11, 1908.
12. *Chionaspis corni* Cooley, on Cornus, August 11, 1908.
13. *Chionaspis furfura* (Fitch), on apple, hawthorn and pear, August 12, 1908.
14. *Chionaspis lintneri* Comst., on Corylus, August 17, 1908.
15. *Chionaspis pinifoliæ* (Fitch), on Pinus sylvestris, August 5, 1908.
16. *Chionaspis salicis-nigræ* (Walsh), on Populus tremuloides, sent to us by Prof. Wm. S. Marshall from Madison, Dane County, December 29, 1908.
17. **Diaspis boisduvalii* Sign., on cycads, palms and various other greenhouse plants.
18. **Diaspis echinocacti cacti* Comst., on cactus.
19. *Aulacaspis rosæ* (Bouché), on raspberry and rose, August 28, 1908.
20. **Aulacaspis zamiæ* (Morg.), on Cycas revoluta.
21. **Hemichionaspis aspidistræ* (Sign.), on Cycas revoluta, ferns and other greenhouse plants.
22. *Aspidiotus æsculi* Johns., on bur oak, linden and pear, July 24, 1908.
23. *Aspidiotus ancylus* (Putn.), on oak, July 25, 1908.
24. *Aspidiotus forbesi* Johns., on hawthorn, July 24, 1908.
25. **Aspidiotus hederæ* (Vall.), on Acacia, Asparagus, Cycas revoluta, oleanders, palms, Yucca, etc. Also sent to us by Prof. Wm. S. Marshall from Madison, Dane County.
26. *Aspidiotus juglans-regiæ* Comst., on linden and maple, July 30, 1908.
27. *Aspidiotus ostreæformis* Curt., on linden and plum, July 30, 1908.

* The greenhouse species are indicated by an asterisk (*).

28. *Aspidiotus perniciosus* Comst., injuriously abundant on Cornus, rose and willow, Forest Home Cemetery, Milwaukee, August 18, 1908.
29. *Aspidiotus ulmi* Johns., on elm, July 21, 1908.
30. [1]*Aspidiotus*, cross between *juglans-regiæ* Comst. and *ostreæformis* Curt., injuriously abundant on trembling aspen and willow, July 9, 1908.
31. **Chrysomphalus aonidum* (Linn.), on oleander, orange and palms.
32. **Chrysomphalus aurantii* (Mask.), found on oranges in the Milwaukee markets.
33. **Chrysomphalus dictyospermi* (Morg.), on Cycas and palms.
34. *Chrysomphalus obscurus* (Comst.), on oak, July 29, 1908.
35. **Chrysomphalus perseæ* (Comst.), found on holly in the Milwaukee markets.
36. **Lepidosaphes beckii* (Newm.), found on lemons and oranges in the Milwaukee markets.
37. *Lepidosaphes ulmi* (Linn.), injuriously abundant on apple, pear and willow; also found on Cornus, currant, hawthorn and linden, July 8, 1908.
38. **Ischnaspis longirostris* (Sign.), on palms.

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[1]Specimens of this scale were sent to Dr. C. L. Marlatt with a note calling to his attention the fact that while the insect which we were sending him resembled to some extent *Aspidiotus ostreæformis* Curt. and *Aspidiotus juglans-regiæ* Comst., it was radically different from either in many characters. The following is offered as an explanation for the resemblance which this insect bears to the two above-mentioned species of Aspidiotus by Marlatt and is quoted verbatim from a letter received from him:

"In my manuscript revision of the genus Aspidiotus I have designated this form as a cross between *juglans-regiæ* Comst. and *ostreæformis* Curt. The former is the American representative of *ostreæformis*, and has developed into a fairly distinct species, differing in notable structural features from its European ally. These crosses have appeared in situations where both species occur, and the reproduction of certain of the structural features of each is such as to make the evidence of crossing very complete and confirms the belief in the not very remote separation of the two species named from a common ancestor. This form, which I believe to be cross bred, bears strongest resemblance to *ostreæformis*, but approaches *juglans-regiæ* in size and in the dorsal pores and in the character of the terminal lobes. The chitinous paraphyses or chitinous thickenings at the base of the lobes are practically as in *ostreæformis*. The paragenitals also approach more nearly *juglans-regiæ*."

Entomological Laboratory, Ohio State University.

NOTES ON APHIDIDAE COLLECTED IN THE VICINITY OF STANFORD UNIVERSITY

By W. M. Davidson

This list is but a preliminary one, since the forms have been studied only during the past year. Doubtless there are many other species in the neighborhood which I have not collected. A few new species have been described, while certain others, showing affinities to described species but possibly new, have been left unnamed for the present. Two or three European forms not heretofore listed in catalogues from America have been observed, generally on imported plants.

Phylloxera vastatrix Planchon; *Vitis.*
Very abundant in a vineyard on the campus, doing much damage.

Chermes pinicorticis Fitch; *Pinus pinastu maritima.*
On the needles during the fall months.

C. coweni Gillett; *Pseudostuga douglasii.*
In large numbers on a young Douglas spruce.

Pemphigus betæ Doane; *Rumex occidentalis* (roots).

P. populicaulis Fitch; *Populus tricocarpa.*

Common on poplars in the fall, and in March when the stem-mothers were founding their colonies.

Colopha ulmicola Fitch; Elm.

Schizoneura lanigera Haus.; Apple.
Very common in apple orchards on the campus.

Lachnus viminalis Fonsc.; *Salix.*
Found in November on the bark of willow. A parasite, *Aphidius* sp., was reared in considerable numbers.

L. abietis Fitch; *Abies concolor.*
In large colonies in the fall on the limbs. No winged forms were seen.

L. pini-radiatæ sp. nov.; *Pinus radiatæ.*

Alate Female

Length of body 2.2 mm.; breadth of body .75 mm.; expanse of wings 7.2 mm.; antennal joints III .48 mm.; IV .28 mm. V .28 mm.; VI .23 mm. Very similar to the apterous female. Cornicles dusky, truncate, very short; cauda green, short, conical; antennæ very pilose, yellow, darker at the articulations of the joints; wings large; stigma greyish brown, long, narrow; basal half of

third discoidal almost obsolete, the two branches running parallel, but being very faint at their point of junction; veins brown, slender, except the second discoidal, which is robust; beak reaches second coxæ. Found on the needles of cultivated Monterey pines, both in the greenhouse and outside. The insect covers itself lightly with a gray flocculent coating. This species shows a certain similarity to *L. californicus* Essig, but is larger in all its measurements and has the antennæ larger in comparison to its length and lacks the red spots in the adult stage.

Apterous Female

With grayish pulverulence removed, dark green; length of body 2.40 mm.; breadth of body .95 mm.; length of beak .55 mm.; antennæ III .50 mm.; IV .25 mm.; V .25 mm.; VI .20 mm.; long, narrow towards the extremities; head dusky; eyes red; antennæ pale, half as long as body, hairy; the last joint and the articulations dusky; thorax and abdomen dark green; cornicles very short, truncate, dusky; cauda green, conical; legs long, especially the posterior pair, dark green; the femora and tibiæ are hairy; tarsi black; beak dusky, barely exceeding the third coxæ.

The young are wholly pale green, except the eyes and abdominal spots, which are pink. The last joint of the antennæ and tarsi are dusky.

Lachnus occidentalis sp. nov.; *Abies grandis.*

Apterous Female

Length of body 2.90 mm.; breadth of body 1.50 mm.; beak .90 mm.; antennæ III .35 mm.; IV .12 mm.; V .20 mm.; VI 18 mm.; dark green or brown; eyes red; antennæ one third as long as body, yellow, sixth joint dusky; head darker than abdomen, short; prothorax dark, with the suture yellow; legs yellow, hairy, the articulations and tip of tarsi black; abdomen broadly oval; cornicles lateral, conical, dusky at the tip; cauda very short, blunt; beak dusky, almost half as long as the body. The young are brown. This species lives in large colonies along the underside of the young shoots of *Abies grandis.* Their presence can be detected by a smoke-colored, flocculent matter, and by the blackening of the leaves from the association of a fungus with their excretions. Ants are always to be found among them, and they are preyed on extensively by a Syrphus fly. This louse occurs on *Abies grandis* in the fall and spring. Winged forms were not seen.

L. alnifoliæ Fitch; *Alnus.*

This large, green, rapidly moving species was taken on the alder in April.

Cladobius salicti Harris; *Salix.*

Taken on willow in November, both sexes.

C. rufulus, sp nov.; *Salix* sp.

Alate Female

Length of body 3.8 mm.; expanse of wings 11.25 mm.; antennæ III .60 mm., IV, .40 mm., V .40 mm., VI .25 mm., VII .27 mm.; head, prothorax and thoracic lobes grayish-black; prothoracic tubercles small, blunt; eyes dark;

antennæ two thirds as long as body, black, hairy, the base of third joint pale; legs black and pilose; basal part of femora green; tibiæ brown, with black apices; abdomen elongate oval, dusky orange, with seven transverse black bars on the dorsum. These bars are sometimes broken in the center and do not reach the lateral margins. There are on the abdomen lateral rows of black spots. Cauda short, pilose, orange, tipped with black; cornicles half as long again as the cauda, pale orange, with dusky tips, contracted for their basal third and again, slightly, at their tips; wings long, narrow; stigma gray, narrow, acutely pointed at the apex; subcosta and insertions dark; veins brown, third discoidal obsolete at its base; origin of second branch near the apex of the wing; beak just reaches posterior coxæ.

Apterous Viviparous Female

Length of body 3.3 mm.; breadth of body 1.5 mm. cornicles .4 mm.; dark green or in some specimens brownish; antennæ pilose, half as long as body, pale yellow, with joints dusky; eyes red; legs brownish yellow, tibial apices and tarsi black; cornicles yellow, slightly clavate, black at their tips; beak reaches first abdominal segment. The body is covered all over with short hairs. Found on the stems and leaves of Salix in April. This species is much attended by ants. A large parasite (*Dieretus*) was bred from infested specimens.

Chaitophorus sp. *Salix.*

A small black species found on the leaves and twigs of willow in April. Alate forms were not found. Length of body 1.80 mm.; breadth of body .9 mm.; head, thorax and abdomen black, with the exception of a median yellow line, which varies in width; body broadest near the posterior end; legs and antennæ grayish; antennæ thick, pilose, almost half the length of the body; III .3 mm., IV .17 mm., V .09 mm., VI .07 mm., VII .1 mm.; cornicles short, tuberculate, broader than long, pale; cauda short, pilose, black; beak exceeding second coxæ; pupa like larva; thorax and wing-pads green. In alcoholic specimens there appear light patches at the base of the cornicles and transverse rows of dots on the abdominal segments. Not having any alate forms, I will not venture to give this species a name, as it has possibly already been described.

Callipterus betulæcolens Fitch; *Betula.*

On the under side of leaves of birches in Palo Alto in May.

C. caryæ Monell; English Walnut.

This little species is very common on walnut trees on the University Campus. I found them in large numbers on the buds and unfolding leaves in March.

C. arundicolens Clarke; Bamboo.

Found sparingly on the under side of the leaves of the bamboo (*Arundo*) in October.

C. ulmifolii Monell; *Ulmus.*

Found in large quantities on the leaves of the elm (*Ulmus*) in the

fall months. A large percentage of the individuals are pinkish. This insect was scarce in the spring.

C. quercus (?) Kalt; *Quercus.*

On both the white oak (*Q. lobata*) and the blue oak (*Q. kelloggii*) I took a species of *Callipterus* having six tubercles on the dorsum. The species is green and is very similar to the *C. quercus* as described in Buckton's Monograph of British Aphides. This insect infests the under sides of the leaves in large companies. It was very common in April and May, though scarce in the fall.

C. tiliæ Linn.; *Tilia.*

This European species was found sparingly on the leaves of linden trees.

Aphis brassicæ Linn.; Mustard.

Very common on the mustard (*Brassica campestris*), where it was abundantly parasitized by an *Aphidius.*

A. rumicis Linn.;

Common on ivy shoots in March; also taken on the vetch (*Vicia*) and *Senecio mikanioides.*

A. ceanothi Clarke; *Ceanothus cuneatus.*

This brown species was found in immense colonies on the tips of the shoots of the mountain lilac (*C. cuneatus*).

A. medicaginis Koch; *Medicago denticulata.*

Found on the bur-clover in April. A Braconid (*Lysiphlebus* sp.) was reared from parasitized specimens.

A. pomi (?) De Geer; Pear.

A dark green species agreeing with *A. pomi*, with the exception that cauda was black and the body dark olive green. Taken in large colonies on pear in May.

Aphis sp.; *Senecio mikanioides.*

Alate Female

Length of body 1.30 mm.; expanse of wings 5.2 mm.; antennæ joints III .3 mm., IV .22 mm., V .12 mm., VI .08 mm., VII .14 mm.; general color dark green; head and thoracic lobes black; eyes dark red; antennæ two thirds length of body, dark green; joints 3 and 4 strongly tuberculate, joints 3, 4 and 5 with small sensoria; abdomen green, paler below; on the dorsum, posterior to the cornicles, there are two cross-bands of dark green; cornicles short, barely exceeding the tarsi, slightly tapering to their apices, almost black; cauda short, green, pilose, globular; legs yellowish green, the joints darker, the tarsi green; veins and stigma brownish grey; insertions pale; veins thin, the discoidals obsolete at their bases; beak pale, reaching the abdomen.

The Apterous female is paler, with the thorax and head yellowish-green. The cornicles are short and pale; legs pale yellow, tarsi dusky; abdomen pale green; antennæ green, one third as long as the body. There is also a rufus form of the apterous viviparous female. Found during the year on *Senecio mikanioides*. It infests the younger shoots and leaves.

Aphis sp.;

A small doubtful species found on both Groundsel (*Senecio*) and *Amsinckia*. The apterous females are green throughout. The alate form has short black cornicles, black bars and spots on the dorsum of the abdomen and the head and thorax black.

Rhopalosiphum dianthi Schrank; *Sonchus.*

Taken in the fall on *Sonchus oleracea,* also on the celestial pepper in a greenhouse. I bred from this insect a very minute wingless dipterous parasite.

R. violæ Pergande; *Viola.*

Found on the cultivated blue violet in May. This form seemed to serve as a link between Pergande's species and that of Essig (Pomona Journal of Entomology No. 1), having the characteristics of both, which appear to me like identical species, despite slight differences in descriptions.

Rhopalosiphum sp.; Almond.

On the stems of a young almond in May I found an aphid (apparently a *Rhapolosiphum*). This is a large red species.

Hyalopterus arundinis Faber; Plum.

In large quantities on the plum in May.

Myzus achyrantes Monell; *Malva parviflora.*

Found commonly on mallow (*M. parviflora*). I bred a small *Aphidius* from this species.

M. persicæ Sulz.; Peach.

On the peach and plum trees in May.

Drepanosiphum acerifolii Thos.; *Acer saccharinum.*

This beautiful species inhabits the leaves of the soft maple (*A. saccharinum*). The winged forms are very active and possess considerable jumping powers.

Siphocoryne salicis Monell; *Salix.*

Found in both the apterous and alate forms under the leaves of willow in April.

S. xylostei Schrank; *Lonicera.*

This European species infests the tips of branches of the honey-

suckle (*Lonicera*) and crowds the leaves in very great numbers, causing them to assume a very unsightly appearance.

Siphocoryne conii sp. nov.; *Conium maculatum.*

On the flower-stalks and leaves of the hemlock.

Alate Female

Head, thorax, cornicles, cauda, tarsi and apices of the tibiæ black; antennæ yellowish-green, a little over half the length of the body; joints 3–6 with sensoria; legs yellow; abdomen bright green; wings penciled over with dots; stigma and veins pale brown; cornicles black, not very incrassate, slightly exceeding the tarsi in length; cauda black, pilose, three fourths the length of the cornicles.

Apterous Viviparous Female

Green; body oval, broadest just behind the middle; antennæ yellow, one third the length of body; joint 3 equals the three following joints in length; eyes very dark red and small; legs yellow; femora and apices of tibiæ black; tarsi yellow; cornicles black, considerably more incrassate than in the winged form, reaching to tip of abdomen; cauda paler, four fifths the cornicles; beak short, not reaching second coxæ.

Length of body (alate) 1.2 mm.; (apterous) 2.75 mm. Length of cornicles (alate) .12 mm.; (apterous) .2 mm. Length of cauda (alate) .09 mm.; apterous) .16 mm. Breadth of body (apterous) 1.15 mm.; wing expanse 4.6 mm.; antennal joints (alate) III .2 mm., IV .12 mm., V .12 mm., VI .20 mm., VII .19 mm.

Parasitized by an *Aphidius*.

Macrosiphum sonchella Monell; *Sonchus oleracea.*

M. rosæ Linn.; *Rose.*

M. pisi Kaltenbach; *Urtica holoscrica* and *Lathyrus.*

M. californica Clarke; *Salix.*

Abundant on tips of willows in April.

M. sp.; *Lupinus* sp.

M. orthocarpus sp. nov.; *Orthocarpus* (owl clover).

Alate Female

Pea green; eyes pink; joints 3–7 of antennæ, tip of beak, distal two thirds of cornicles, tarsi, apices of femora and tibiæ black; thoracic lobes orange brown; lower side of thorax brown; antennæ slightly longer than the body; joint I is gray, three times as large as II, which is paler; joint III is longest; femora very pale (except the apex); tibiæ brown; abdomen, head, prothorax, base of cornicles, and cauda bright pea green; cornicles not quite reaching tip of cauda, cylindrical, .7 mm. in length; cauda, pointed, pilose, .35 mm. in length; wings long and narrow; stigma pale brown; insertions and subcosta green; veins deep brown; beak not quite reaching second coxæ; length of body 3 mm.; expanse of wings 8.5 mm.; breadth of body .95 mm.; antennal joints, III .85 mm., IV .6 mm., V .5 mm., VI .12 mm., VII .8 mm.

Apterous Viviparous Female

Bright pea green, larger than the alate form; antennæ and distal two thirds of cornicles black; body more than half as broad as long (excluding cauda); eyes red; antennæ reaching just beyond tip of cauda, black, except joints I, II and base of III very similar to that of the winged female; legs pale green; apices of tibiæ and tarsi dark brown; cornicles not quite reaching tip of cauda; cauda green, tapering, about one half the length of cornicles; beak short, barely reaching second coxæ, the tip black.

The young are very pale, with large red eyes and the distal antennal joint dusky. Found sparingly among the flower spikes of *Orthocarpus purpurascens* in April.

Scientific Notes

Stable Fly. In the Bulletin de la Société Nationale d'Acclimatation de France, March, 1909, Lucien Iches has published a very interesting article on *Stomoxys calcitrans* and Argentine cattle, giving the results of a brief investigation made by him last year in the province of Santa Fé, Argentina. *Stomoxys calcitrans* swarmed on a large estate in almost incredible numbers. The cattle were nearly driven crazy by them. Certain valuable Durham bulls which were observed were covered with flies, had lost their hair in large spots, and the skin was cracking. Monsieur Iches naturally sought at once for the principal breeding places of the flies, and found them to be in the stacks of debris from the threshing of wheat and flax. Larvæ and puparia were found by the millions in the lower portions of these piles of straw, where some fermentation had already begun. The sensible measure which he recommended was to have this debris burned within forty-eight hours after the completion of the threshing, the ashes being used for fertilizing purposes. It seems that there exists in the province of Santa Fé an old provincial law ordering the burning of the debris after threshing, but that it has not been enforced of late years. L. O. H.

Insects on Imported Nursery Stock. The discovery of the nests of the brown-tail moth on foreign importations of seedlings into the State of New York has prompted a very close inspection of nursery plantations this summer for caterpillars of this species, which might possibly have escaped treatment at the time of the planting of the stock in the nurseries. With this close supervision of nurseries, there have been found on foreign seedlings eggs of the Rusty Tussock Moth (*Notolophus antiqua* Linn.) and several colonies of the larvæ of the Little Ermine Moth (*Hyponomeuta padella* Linn.) which were feeding on cherries. These were collected and brought into our laboratory for identification by Messrs. Fred Wiley and John Maney respectively, who are official nursery inspectors.

According to Judeich and Nitsche, *H. padella* thrives on the service tree, wild plum, hawthorn, medlar and on various species of Pyrus. Theobald says that in England this species feeds normally on hawthorn, often quite defoliating hedgerows, and also attacks cherry and plum. In France it is said to subsist on cherry and plum and in Italy on plum.

P. J. PARROTT.

Snow-white Linden Moth. (*Ennomos subsignarius* Hubn.) The serious injuries to beech and other forest trees of last year were continued this season in New York State by extensive depredations in the vicinity of Cooks Falls, Delaware county, in the town of Denning, Ulster county, and about Dahlia, Sullivan county. The remarkable urban flights of this species recorded last year in widely separated Hudson river and Mohawk valley localities were repeated in New York City and some other Hudson valley localities, at least.

E. P. FELT.

Aphididae or plantlice. The early part of 1909 has been noteworthy because of the remarkable abundance of these insects in New York state upon various trees and shrubs in particular. The outbreak of this season is comparable only with that of 1897 and 1903, years distinguished by the superabundance of plantlice in New York state. Observation and weather records show a correlation between an unusually low temperature and the multiplication of aphids. The present season was remarkably cool and backward, a marked change for the better occurring June 21, accompanied by the rapid development of natural enemies, such as lady beetles and Syrphidae or flower flies in particular. These latter became so numerous as to practically wipe out the hordes of plantlice by the end of the first week in July. Climatic conditions similar to those described above prevailed in New York state during the outbreaks of six and twelve years ago. It is interesting, in this connection, to note that recent observations on the spring grain aphis in the southern and middle states by agents of the Bureau of Entomology have shown a correlation between temperature and the development of plantlice and their enemies. Experiments with this species demonstrated the futility of large importations of parasites in the expectation of hastening its control. The writer should not be understood as taking the position that unseasonably low temperatures are invariably accompanied by plantlice outbreaks, though there is no doubt but that such conditions have an important influence upon the development of these pests.

The following species were unusually abundant or destructive. The green apple aphis, *Aphis pomi* DeG., and probably its associated species, was excessively abundant and injurious in the important fruit sections of the state. A plum aphid referred by Mr. Pergande to the genus Siphocoryne was very numerous. The common cherry aphis, *Myzus cerasi* Linn., destroyed most of the tender leaves, on young trees in particular. Hard maples, especially the Norway maple, in widely separated parts of the state, were very badly infested by *Chaitophorus aceris* Linn. A very large amount of honeydew was produced, and in not a few instances ten to twenty-five per cent. of the leaves dropped, the latter due in large measure to plantlice infestation. The inconspicuous *Callipterus ulmifolii* Mon. was unusually abundant on elms at Dunkirk and Fulton, N. Y., considerable annoyance being occasioned by the large amounts of honeydew, not to mention the injury to the trees. The woolly elm leaf aphid, *Schizoneura americana* Riley, was also excessively numerous in some localities. The cockscomb elm gall, *Colopha ulmicola* Fitch, was unusually abundant, occasional trees having most of the foliage seriously deformed. The beautiful *Drepanosiphum acerifolii* Thos. was very abundant and rather injurious to soft maples in particular. Weeping birch at Albany and Hudson, N. Y., was very badly infested by *Hamamelistes spinosus* Schim.,

a species with a remarkable life cycle and better known on account of the peculiar spiny bud gall it produces on witch-hazel. *Callipterus betulaecolens* Mon. was abundant on certain birches. Ornamental, particularly purple beeches, were badly affected by the woolly beech leaf aphid, *Phyllaphis fagi* Linn. One small tree noted had its foliage nearly destroyed by this species. The pine bark aphid, *Chermes pinicorticis* Fitch continues abundant in the vicinity of Albany, and is probably responsible in large measure for the gradual destruction of two groups of young pines in Washington Park, Albany, N. Y. The woolly larch aphis, *Chermes strobilobius* Kalt., was numerous, though not excessively abundant. The work of the spruce gall louse, *Chermes abietis* Linn., is very evident in some localities, and in Washington Park the peculiar destruction of the buds without the production of the characteristic galls continues and appears to finally result in the death of branches, or even the entire top of a tree.

E. P. FELT.

Brown-Tail Moth (*Euproctis chrysorrhœa* Linn.). A small infestation was discovered late in June in the town of Rye, near the village of Port Chester, and only about a thousand feet or so from the Connecticut state line. Only sixteen caterpillars or thereabouts were discovered after repeated inspections. The infested area and its vicinity has been thoroughly burned over several times with a cyclone burner and, in addition, the few trees and shrubs in the vicinity have been repeatedly sprayed with a contact insecticide. Trap lanterns have also been operated and a close watch is being kept for the appearance of moths. No expense is being spared in an attempt to exterminate this infestation.

E. P. FELT.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

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The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints of contributions may be obtained at cost. Minor line figures will be reproduced without charge, but the engraving of larger illustrations must be borne by contributors or the electrotypes supplied. The receipt of all papers will be acknowledged.—EDS.

The peculiar meteorological and entomological conditions obtaining in New York State the present season indicate the desirability of more exact and generally applicable information respecting the influence of climate upon the development and abundance of various insects. It is well known that variations in temperature and moisture have a profound influence upon the development of certain species, and it is more than probable that the relative intensity of light influenced by the presence or absence of clouds is also an important factor. The early part of the season of 1909 was remarkable for its coolness, accompanied by a retardation in the development of vegetation. The same was true in 1903 and in 1897—all years accompanied by a superabundance of plantlice. Is there a correlation between the two phenomena? Entomologists in other parts of the country must have witnessed similar conditions, most of which, we fear, are allowed to go unrecorded. Knowledge of this kind, if generally applicable, would be invaluable to the economic entomologist, and we would suggest that data along these lines is at least worthy of record and might, under certain conditions, be tested experimentally. There is certainly an inviting field for any one willing to study carefully the connection existing between climate and the development of insects. There are already a number of records showing a most intimate relation between meterological conditions and the growth and multiplication of certain injurious species, while the influence of minimum temperatures has been the subject of careful studies by several observers.

There is another general subject deserving attention at the present time. Recent years have witnessed numerous outbreaks by leaf feeding caterpillars, particularly in forests. New York State, for example, suffered greatly about 1900 from extensive depredations by the forest tent caterpillar. Forests were severely injured in 1906 and 1907 by the green striped maple worm and the snow-white linden

moth, the latter continuing its devastations the present season. It is believed that these outbreaks are due in large measure to the scarcity of native insectivorous birds. Can this be substantiated by observations in other parts of the country or proved by experimental data? Are birds more efficient natural checks upon our forest fauna than insect parasites and fungous diseases? Various entomologists must possess unpublished data of much value along these lines and we would like to see it collaborated in order that the evidence may be carefully weighed and we be in a better position to judge as to the relative efficiency of the various factors maintaining a balance between insect and vegetable life.

Reviews

Codling Moth Investigations, by E. D. Sanderson. 19th and 20th Reports of the New Hampshire College of Agriculture and Mechanic Arts, p. 396–498, 1908.

During the past few years the codling moth has received attention at the hands of numerous investigators, and much has been added to our knowledge of this important apple pest. A recent contribution to the subject is that by Professor Sanderson, comprising somewhat more than one hundred pages, with numerous half-tone illustrations which add materially to the clearness of the text. The article deals primarily with the codling moth in New Hampshire and includes results of observations for the past three years. It is especially timely, since heretofore there has been but little exact information on the seasonal history of the insect in the New England States, representing temperature conditions different from those prevailing in other fruit-growing regions where the species has been carefully studied. A large amount of data is presented and a large series of experiments with remedies are reported upon in detail.

Under the remarks on hibernation is shown the distribution of codling moth larvae on the trees during the hibernation period, and also the winter mortality of larvae under natural orchard conditions—facts not previously determined. An examination of seven apple trees in May, 1907, showed that out of 385 cocoons found, 70 per cent. were located on the trunk, and the remainder on the main branches. Of the larvæ on the trunks, 97 were within one foot of the crotch; 112 within one foot of the ground; and 60 were between on the middle portion of the trunk. The mortality records of larvae on the seven trees show that 5 per cent. only were alive at the time of examination; 87 per cent. had been killed by birds; 4 per cent by fungous disease; and 3 per cent. by cold.

Data is presented to show the relation of temperature to the pupal stage, and it is calculated that for spring pupae from 470 to 480 degrees are required above 30 degrees F., practically a thermal constant. It is apparent,

however, that these conclusions are permissible only in a very broad way, and it must be admitted that in the case of this and other insects thermal constants have not been established with any degree of definiteness. Temperature studies of this character, however, are of much possible practical importance, but information is needed on other influencing factors.

The distribution of eggs on the apple trees has been well determined, involving an immense amount of work. In general, it appears that eggs are deposited promiscuously over the foliage, twigs, and fruit, much the majority of the eggs being placed on the leaves and without any reference to the nearness of the fruit.

A distinct advance is made in our knowledge of the feeding habits of the newly hatched larvae, as it is shown by repeated observations that these feed freely upon the foliage, mining into the leaves and boring into the tender shoots. Larvae in breeding cages were reared to maturity on foliage alone, and the author considers that such feeding probably occurs in orchards. This bears directly upon the question of the value of spraying the trees at a time when the larvae are hatching in maximum numbers, as three or four weeks after the petals fall; and also upon the possibility of extermination of the insect during off crop years and in the case of total failures of crop in restricted orchard regions, as has been recently admitted in the Southwest.

Statistics are presented showing the places of entry of apples by larvæ. Records from nine orchards show a variation of from 39 to 77 per cent. of first-brood larvae entering at the calyx end on unsprayed trees, with an average of 65 per cent. Of the second brood larvæ, from 22 to 29 per cent. were found to enter the fruit at the calyx end, the average being 46 per cent. This is lower than has been reported by other workers, as by Messrs. Simpson, Ball, and Pettit.

The proportion of first-brood larvae which develop to pupae and moths, in New Hampshire, is, fortunately for the apple grower, quite small. From the observations and band records of Professor Sanderson, it is shown to be not more than 3 per cent., and he considers that it may not be more than 1 or 2 per cent.

It is to be regretted that a summary was not given showing the length of the life cycle of the codling moth, as based on the average figures for the respective stages. This may not be computed from lack of data on length of pupal stage of the first generation.

Under "Experiments in Spraying for the Codling Moth,' a large amount of detailed data is given, covering the work in several orchards during the years 1906, 1907, and 1908. The plan of work, as outlined on page 416, is comprehensive, and it would have been an advantage had the results been briefly summarized in conformity with the outline.

A schedule of applications of sprays, as based on the work reported, would also have been an advantage, and would doubtless be applicable to the New England states as a whole. Professor Sanderson well points out the desirability in spraying for the codling moth of having plats of sufficient size and of using a sufficient number of trees to avoid possible complication from overflow of moths from one plat to another, and of securing counts from a sufficient number of trees to eliminate as much as possible the individual variations in the percentage of worminess. In the

method of recording and tabulating results, a somewhat complicated though accurate plan is adopted (p. 441).

An attempt to separate the effect of poisoning the calyx cavity only, by the use of an atomizer, and of spraying foliage only (the fruit being covered by paper bags) did not furnish very definite results, attributed by Professor Sanderson to the fact that in spraying with the atomizer for the calyx cavity only, the exterior of the fruits also are poisoned to a greater or less extent.

In the comparison of "Drenching vs. Mist Sprays," it can hardly be claimed, in the writer's opinion, that the conditions for drenching work, as recommended by western entomologists, have been entirely met. Thus, the pressure (a most important factor in the work) in 1907 and in one orchard in 1908 was only from 80 to 100 pounds; and in 1908 from 110 to 120 pounds—in both cases considerably below the pressure specified for effective work. The author concludes: "It is entirely evident from the large amount of data from these five plats that the drenching spray has no particular advantage over the mist spray, except as it may deposit more material on the foliage and apple." The reason is held to be found in the condition of the calyx. In the West, as shown by the figures of Doctor Ball, the calyx cavity is still open two weeks after blossoming and by which time the stamen bars have shriveled. This condition for the East, in the case of the Baldwin apple, was found not to obtain, as the calyx lobes are closed in about one week or at the most ten days after blooming, while the stamen bars at this time are still turgid, preventing the enforcement of the spray into the inner calyx cup.

The report is a most creditable one and shows an enormous amount of detailed work on the part of Professor Sanderson and his assistant, Mr. Wilson, and his former assistant, Mr. T. J. Headlee, constituting a very valuable addition to our literature on this subject.

A. L. QUAINTANCE.

Fighting the Insect Pests and Diseases of Orchard, Field and Garden Crops, by H. L. Price. Va. Agric. Exp't Sta. Cir. 7, p. 1–112, 1909.

This new departure comprises a concise though comprehensive illustrated discussion of the principal insect pests and fungous diseases affecting field and garden crops.

The Report of the Entomologist, by C. W. HOWARD. Transvaal Dep't of Agric. Rep't. 1907–1908, p. 164–209, 1909.

This report gives a detailed account of the locust work and incidentally offers a striking illustration of the difficulties under which such operations may be conducted at times. The occasional necessity of drawing water for spraying purposes some twenty miles would appear like a severe hardship to American horticulturists. The extent of the locust work conducted by the Transvaal is illustrated by the expenditure of some $30,000 against the brown locusts. The value of this discussion is greatly increased by a series of maps showing the infested areas. A number of the more injurious insect pests are noticed briefly. There is an extended account, accompanied by

valuable experimental data, on methods of protecting wood from the ravages of white ants. The author's experiments indicate that solutions containing arsenic and also many of those composed in part of tar, creosote and carbolic acid compounds are excellent preventives against these pests.

Current Notes

Conducted by the Associate Editor

Professor C. F. Adams has been promoted to Dean of the College of Agriculture and Director of the Agricultural Experiment Station in the University of Arkansas. He will also continue in the Chair of Entomology in the University.

Mr. Paul Hayhurst has been appointed Assistant Entomologist in the above institution.

The following appointments have been made in the Bureau of Entomology, United States Department of Agriculture, since May 1:

Citrus Fruit Investigations, Mr. J. F. Zimmer.

Deciduous Fruit Investigations, W. Postiff, C. W. Hooker, E. J. Hoddy, E. W. Scott, J. R. Horton.

Forest Insect Investigations, Josef Brunner, T. E. Snyder.

Southern Field Crop Insect Investigations, T. C. Barber, W. H. Hoffman, Jr., T. E. Holloway, F. L. Elliott, W. V. King, O. M. Lander, V. I. Safro, George A. Runner.

Truck Crop and Stored Product Insect Investigations, Thomas H. Jones.

Gypsy Moth Investigations, C. W. Collins, W. R. Thompson.

Prof. Glen W. Herrick, Entomologist to the Texas Agricultural Experiment Station, has been appointed Professor of Entomology at Cornell University, vice Prof. M. V. Slingerland, deceased.

We regret to announce the recent death of M. Vallery-Mayet at Montpelier, France. He was an enthusiastic entomologist and owned a large and very valuable collection.

Mr. E. J. Krauss has resigned as assistant in the Bureau of Entomology and has accepted the position of Assistant Entomologist at the University of Washington, Pullman, Washington.

Dr. C. Gordon Hewitt, lecturer in economic zoölogy in the University of Manchester, Manchester, England, has been appointed Entomologist of the Dominion of Canada, vice Dr. James Fletcher, deceased.

Dr. H. B. Ward has resigned as Dean of the College of Medicine and Department of Zoölogy at the University of Nebraska to become Dean of the Department of Zoölogy at the University of Illinois.

The gypsy moth law in Massachusetts was amended at the recent session of the Legislature and the work on the gypsy and brown-tail moths was placed in charge of the State Forester, Prof. F. W. Rane. Mr. L. H. Worthley, who was assistant superintendent under the old law, has been appointed Assistant Forester in charge of Moth Work.

Dr. O. A. Johannsen, Instructor in Civil Engineering at Cornell University, has been appointed Entomologist at the Maine Agricultural Experiment Station.

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RELATION OF INSECTS TO HUMAN WELFARE[1]

By H. A. Gossard

Long ages before the earliest mammal appeared on earth multitudinous individuals representing diversified types of insect life had found congenial homes in prairie, forest and desert, if such terms may be correctly applied to landscapes differing in most respects from any which have ever been seen or named by human kind. Above the earth, on its surface, in its caves, and on and in its waters these creatures fed and multiplied as now. Well back towards the morning twilight of geological history, in the Silurian age, and in greater numbers in the Devonian, when the fishes represented the culminating point reached by the animal kingdom and a true forest vegetation for the first time clothed the youthful world, the types represented by

[1]The following paper was compiled by the writer for the information of the Century Club, a small association of literary, scientific and professional men of Wooster, O. The only merit, if any, to which the paper can lay claim is that of an example of popular writing that helps to mold a friendly sentiment among intelligent and influential men, and eventually brings enlarged resources for work and investigation to the economic entomologist. A careful scrutiny of the composition will disclose among the authorities and papers which have been drawn upon the following in particular, from which, in some cases, quotations have been made with but little or no change from the original text:

Second Report United States Entomological Commission on the Rocky Mountain Locust.

Review, in Science, by Doctor Howard of the History of Economic Entomology for Fifty Years.

The Gypsy Moth, by E. H. Forbush.

The Brown-Tail Moth, Fernald and Kirkland.

Flies and Ticks as Agents in Distribution of Disease, by F. V. Theobald.

The Economic Status of Insects as a Class, by Dr. L. O. Howard.

the cockroach and the mayfly heralded the oncoming myriads of their congeners which yet endure and probably will endure as long as the world sustains life. One of our entomologists in forecasting the likelihood of the long survival of the insect class breaks forth in the following poetic language: "When the moon shall have faded from the sky and the sun shall shine at noonday a dull cherry red, and the seas shall be frozen over and the ice-cap shall have crept downward to the equator from either pole, and no keel shall cut the waters, nor wheels turn in mills, when all cities shall have long been dead and crumbled into dust, and all life shall be on the very last verge of extinction on this globe, then, on a bit of lichen, growing on the bald rocks beside the eternal snows of Panama, shall be seated a tiny insect, preening its antennæ in the glow of the wornout sun, representing the sole survival of animal life on this, our earth,—a melancholy 'bug.' "[2]

The long period through which the Class Insecta has existed has caused it to develop an almost incredible number of species, some among them adapted to every condition of climate and topography on the globe. Excepting the microscopic forms of animals and plants, the number of all other species of living things added together, mammals, birds, fishes, reptiles, animals of whatsoever class, trees and plants total together but a small fraction of the number of species in the insect world. The number of species is variously estimated at from 2,500,000 to 10,000,000, with the probabilities favoring the latter figure as the more nearly correct. Assuming the maximum figure to be correct, in what a field does the entomologist find himself! Suppose that he attempts to familiarize himself with each species so that he will recognize it the next time he sees it. Since his task is obviously great, we will start him at it at the age of five years and allot him five minutes in which to study each species, giving one half of the time to a male specimen and one half to a female. Lest he should become lazy, we will provide him with electric lights and keep him working day and night, and lest he should become fat, we will forbid him to eat except as he is able to snatch mouthfuls from the five-minute intervals during which he is expected to fix in his memory the anatomical characters, color patterns, etc., which differentiate each species from every kindred one. Working in this manner and at this rate, the rains of nearly one hundred summers will have fallen on his roof before the last representative of the long procession of insects has passed before him, and he is permitted to step outside his door to renew his childhood and behold a real live grasshopper

[2]W. J. Holland, end of Moth Book.

jump or a gorgeously winged butterfly dance over the meadows. And if we accept the smaller estimate as correct, we have only to reduce the daily working hours to twelve, and allot ten minutes instead of five for the study of each species to obtain precisely the same result. And yet there are people who are surprised if a professional entomologist fails to promptly recognize every specimen submitted to him for identification! The descriptions of about 300,000 insects have been written and published. The undescribed forms are, many of them, small, and many inhabit but partially explored regions of the earth, such as the tropics of South America and Africa.

Fortunate it is for mankind that the insect world is a house divided against itself, otherwise the greenest and most fertile lands in the world would shortly become lifeless deserts. Except for the check put upon insect multiplication through warfare within the insect household, by which one species of insect destroys its relatives, no informed naturalist would expect the survival of the human race for a longer period than five or six years. Not only would man's food supply be appropriated by his insect enemies, but it would be impossible for him to withstand the withering march of malaria, yellow fever, typhoid, bubonic plague, sleeping sickness and other maladies transmitted through insect carriers, that would consume like a devouring fire and leave in their track a desolation compared with which the plagues of Egypt were happy visitations, though these were in part insect outbreaks. The fecundity of insects is amazing. Huxley estimated that a single aphis or plant louse would produce in ten generations, if no mishaps occurred to cut short the natural life of any of her descendants, a mass of organic matter equivalent to the bulk of 500,000,000 human beings or the whole population of the Chinese empire. The common apple plant louse has normally about eight generations in one season, the greater proportion of the individuals failing for various reasons to reproduce, the chief cause of repression of multiplication being the work of insect parasites and predaceous insect forms, which for so long a time and with such certainty of result have transformed a potential peril into a well-balanced condition of safety that we give but scant attention to the aphids, and only occasionally find it advisable to turn on them our batteries of insecticides, to do clumsily and expensively what nature does without noise or change from her customary processes.

Insects render themselves obnoxious to man in two ways: First, by partially or wholly destroying his crops and harming his domesticated animals; and second, by attacking him directly, either inflicting pain upon him or inoculating him with disease, some forms of which

are enervating and others dangerous to his life. From the earliest historic times he has suffered from both forms of injury, but naturally the early records refer most frequently to famine conditions resulting from crop destruction, the causes of which were obvious to all observers, while the office of insects as carriers of disease was, in early days, very imperfectly understood and, for the most part, not suspected at all. Among the plagues visited upon Egypt in the days of Moses was one of lice "in man and in beast," and swarms of flies were promised to Pharaoh in these words: "I will send swarms of flies upon thee and upon thy servants and upon thy people and into thy houses; and the houses of the Egyptians shall be full of swarms of flies and also the ground whereon they are." The plague of locusts is said to have "covered the face of the whole earth so that the land was darkened; and they did eat every herb of the land and all the fruit of the trees which the hail had left; and there remained not any green thing in the trees or in the herbs of the field through all the land of Egypt."

To merely enumerate the locust invasions paralleling the Egyptian outbreak that have since been recorded in various parts of the world would require many sheets of manuscript, but let us pause long enough to glean a few quotations. Pliny, the Roman naturalist, writing from 50 to 79 A. D., says: "Their numbers are so vast that they quite darken the sun. Those from Africa are the ones which chiefly devastate Italy; and more than once the Roman people have been obliged to have recourse to the Sibylline books to learn what remedies to employ under their apprehensions of impending danger." Beauplan, writing of a swarm that visited the Ukraine in 1645 and 1646, says: "These creatures do not come in legions but in whole clouds, five or six leagues in length and two or three in breadth, and generally come from towards Tartary. These vermin being drove by an east or southeast wind come into Ukraine, where they do much mischief, eating up all sorts of grain and grass, so that wheresoever they come in less than two hours they crop all they find, which causes great scarcity of provisions. It is not easy to express their numbers, for all the air is full and darkened. In June, 1646, having stayed two months in a new town, called Novogorod, where I was building a citadel, I was astonished to see so vast a multitude, for it was prodigious to behold them, because they were hatched there that spring and, being as yet scarce able to fly, the ground was all covered and the air so full of them that I could not eat in my chamber without a candle, all the houses being full of them, even to the stables, barns, chambers, garrets and cellars. I caused cannon powder and

sulfur to be burnt to expel them, but all to no purpose, for when the door was opened an infinite number came in, and the others went out, fluttering about. And it was a troublesome thing when a man went abroad to be hit on the face by those creatures, sometimes on the nose, sometimes on the eyes, and sometimes on the cheek, so there was no opening one's mouth but some would get in. Yet all this was nothing, for when we were to eat, these creatures gave us no respite, and when we went to cut a bit of meat we cut a locust with it, and when a man opened his mouth to put in a morsel he was sure to chew one of them. I have seen them at night, when they sit to rest them, that the roads were four inches thick of them one upon another, so that the horses would not trample over them, but as they were put on with much lashing, pricking up their ears, snorting and treading very fearfully. The wheels of our carts and the feet of our horses bruising those creatures, there came from them such a stink as not only offended the nose but the brain. I was not able to endure the stench, but was forced to wash my nose in vinegar and hold a handkerchief dipped in it continually to my nostrils."[3] Some of my hearers doubtless remember the devastation wrought in the states of the western Mississippi valley from the close of the Civil War until about 1876. So serious was the locust plague in some of the richest of these states that immigration to them was greatly discouraged, and the settlers already there were subjected to the severest privations. Every year local districts or great areas in the provinces of the British Northwest, in the Dakotas, in Minnesota and in neighboring states must wage vigorous warfare against some of the various species of grasshoppers, often piling the dead insects captured in the hopper-dozers in windrows and heaps of such extent that the air for miles is polluted with the stench.

The mighty power of destruction possessed by these insects when massed together may be inferred from the extent of a swarm passing over the Red Sea in November, 1889, which spread out over 2,000 square miles in area; and from the fact that in the island of Cyprus in 1881 1,300 tons of locust eggs were destroyed.

To instance other insects with extraordinary capacity for damage, the Hessian fly may be cited. It attacks wheat, barley and rye. Professor Webster estimated that the damage in Ohio for the season of 1900 alone amounted to more than $15,000,000. For the entire United States the average annual damage caused by Hessian fly is considered by the best informed experts to be about $40,000,000. The chinch bug is estimated to inflict an average annual loss of $7,000,000 on the

[3]Taken from Second Report U. S. Ent. Comm. on Rocky Mountain Locust.

wheat growers, or, if during the past fifty years any person could have appropriated to himself the wealth which this insect has destroyed he would be worth $350,000,000 with accrued compound interest and earnings to be added thereto, and could invite Mr. Rockefeller to take second place in the magnate row. The Mexican cotton boll weevil crossed the Rio Grande River into Texas in the early '90s and, advancing over the cotton-growing territory at an average rate of seventy-five to one hundred miles annually, has now reached Arkansas and the Indian territory on the north and the valley of the Mississippi on the east. "The damage it has done and the fears it has aroused in other cotton-growing countries have threatened a disturbance in the balance of trade for the entire world."[4] The damage inflicted by this insect during the seasons of its greatest abundance is estimated to have been from $15,000,000 to $30,000,000. In 1894 it damaged the crop in Texas alone to the extent of $8,000,000. The gypsy moth was introduced into America by accident in 1868 or 1869. A French naturalist, artist and astronomer, living at that time near Glenwood, Medford, Mass., was experimenting in raising silk with our native silkworms, and also imported European species for the same purpose. Among his shipments were the eggs of the gypsy moth and a gust of wind is said to have carried some of them through an open window. Mr. Trouvelot was greatly disturbed by the accident, and failing after diligent search to find the eggs, gave public notice of the calamity, much to the amusement of his neighbors, who were unable to understand his anxiety. During the first ten years after its escape no one, except Mr. Trouvelot, is known to have observed it. Twenty years after its escape, in 1889, the first extensive outbreak occurred. Since its first outbreak it has spread over extensive districts in Massachusetts, and has also appeared in the neighboring states of Rhode Island and New Hampshire.

A resident of the infested district in Massachusetts gives the following description of the ravages of the gypsy moth: "The caterpillars were so thick in the trees that you could hear them eating. They would get on the fences until they made them fairly black. They would crawl upon and into the houses. They would get inside somehow, and it was a common thing to see them crawling upon a table, and we have even found them on the beds. They would get under steps, stones and into old stovepipes, old cans, boxes, in short any place which afforded shelter. They crawled into the cellar windows. They were so thick on the street trees that people would walk out in the middle of the street, where there were fewer dropping down. It is no exaggeration to say

[4]Dr. L. O. Howard in Science.

that I have raked quarts of caterpillars off a tree. I have seen them crawling in great numbers on the rails of the Medford branch track. After a train had gone along the rails would be all green with their crushed bodies." Another writes: "Before public measures were taken in the matter, the foliage was completely stripped from all the trees in the eastern part of our town, presenting an awful picture of devastation and promising in a short time to kill every tree and shrub and all vegetation in any region visited by these creatures," which shows how inadequate individual effort was to cope with the subject.

The brown-tail moth, also scattered through the New England states, well nigh rivals the gypsy moth in destructiveness to vegetation and because of its barbed hairs, which are poisonous, it makes itself the more disagreeable of the two to human beings. One of the victims writes: "We were shockingly poisoned by the caterpillars of the brown-tail moth. They troubled us all summer. Every member of my family was poisoned. At first we did not know what they were. My little boy could not go near the insects without getting poisoned. Every time he went to pick cherries he would come down from the tree badly poisoned. If my baby went near where they were his face would break out into a rash. I was so dreadfully poisoned that I thought I had some frightful disease. My hands, face and arms were broken out with this rash. The caterpillars came into the house and even into the closets. They would get on the clothes hanging on the line and when these were worn they poisoned us."

The codling worm of the apple causes a yearly loss of $10,000,000 to $15,000,000. The San José scale causes the death of millions of fruit trees each year, and stored corn in the seven Gulf States alone is estimated to suffer damage from insects to the extent of $20,000,000. The Texas fever tick, by discouraging the production of cattle in nearly all of the southern states, has inflicted upon that section a loss that can scarcely be calculated. When we run over the list of lesser pests which exact their toll from our fields, pastures, orchards, gardens, forests and herds, we can hardly consider as excessive the estimate that one tenth of the entire agricultural product of the country, or $300,000,000 per year, is contributed to the support of our small but mighty foes. A few years ago the writer estimated that the average Ohio farm of 88.5 acres suffers an average annual loss of $93.12, the total annual loss for the 276,719 farms of the state being $25,768,073.28, a sum which would support the Ohio Agricultural Experiment Station on the basis of the expenditures for 1904 for 547 years; or by a similar computation it would sustain the Ohio State University, the Ohio State Board of Agriculture and the Ohio

Agricultural Experiment Station combined for sixty-seven years; or it would nearly support the entire educational system of the state for one year.

I have already referred to the relation between the fever tick and Texas fever in cattle in the United States. On the east coast of Africa a similar highly fatal disease, known as African Coast fever or Rhodesian fever, affecting cattle, is carried by a different species of tick. Other tick-borne diseases are heartwater in sheep and cattle; malignant jaundice in dogs, and spirillosis in fowls. Amongst biting insects the Tsetse flies have long been known to slay the horses of African travelers, and we now know that this same genus of flies is responsible for the mysterious and fatal sleeping sickness that has decimated the population in west and central Africa. In Busoga alone 30,000 natives have died in the space of three years from this cause. These flies carry from inoculated to healthy persons certain parasitic protozoans, called trypanosomes, which live in the blood and spinal fluid of man and animals. Recent investigations have shown that crocodiles are intermediate hosts for the protozoans, and if these animals were destroyed it is believed that sleeping sickness would cease. The disease known as anthrax or black-leg in cattle has been communicated to man by bites of horse flies and the common stable fly, and there is little or no doubt that this disease is carried from sick to healthy animals by these insects Circumstantial evidence leaves scarcely a doubt that fleas carry the bubonic plague, not only from person to person, but between rats and men. At the time of a bad outbreak of the plague at Sidney, Australia, it is recorded that rat fleas became so numerous on the wharf at Sidney that the laborers had to tie string around the bottom of their trousers to protect themselves from the vermin. British troops at Hong Kong, only provided with boots, were much bitten by fleas and many contracted plague. The British troops in India, walking in "putties," do not contract it because the fleas cannot get at their ankles. Within recent years mosquitoes have been proved to act as carriers of malaria and yellow fever. By waging war against the various species of Anopheles which act as malaria carriers the number of cases in Ismalia on the Suez Canal, where the number of cases of fever have always been between 1,500 to 2,000 per annum, was reduced in one year to 209. When work was begun on the Panama Canal the region through which it was to be constructed was excessively dangerous to human life, but today the workmen can sit on their outside porches in the evening without being sheltered behind gauze netting, so effectually have the mosquitoes been exterminated. The extent of malarial infection in some regions

may be gathered from such figures as these: In 1900 deaths from fever (unclassified) in India amounted to 4,919,591, most of the cases being in all probability malarial. That is, a population, greater than that of the state of Ohio, was carried off in a single year. The hospital returns from the Indian army report that in this same year the army amounted to 60,653 men, of which 19,445, or nearly one third were so badly incapacitated by malaria that they were obliged to quit duty and receive hospital treatment. The blood parasites or protozoans which cause malaria reproduce in man's blood and fresh generations invade the red corpuscles, causing chills. Anopheline mosquitoes, sucking up the asexual forms of the parasite with the blood, carry these in their stomachs and salivary glands until a sexual generation is produced. The latter form of the parasite is injected into the blood of the next human victim bitten. Yellow fever is carried by the tiger or brindled mosquito, a sprightly, rapid-flying insect, found over the southern states and as far north as Kentucky, also in the West Indies, in South America, in the European countries bordering the Mediterranean and across Asia to China. Wherever the species occurs and a yellow fever patient goes there is always a chance of the dread disease spreading. Ships may convey infected mosquitoes long distances. This species breeds largely in barrels, cisterns, fountains and discarded tin cans in which fruits, vegetables, fish, etc., have been preserved. Anything that holds water is inviting to them. Before the American occupation of Cuba the deaths in Havana varied during the period 1889 to 1900 from 118 to 1,355 per year. In 1901, the first year in which a systematic and wholesale warfare was directed against the mosquitoes, the number of deaths was reduced to five, and in 1902 not a single case occurred. The disease known in tropical regions as elephantiasis or Filariasis is also carried by mosquitoes. This disease is caused by minute parasitic worms, which live in the skin and the lymph. The skin becomes thickened like an elephant's hide, hence the name of the disease. Doctor Graham of Beyrout states that dengue or Dandy Fever is carried by a species of Culex. There is good reason for thinking that fleas transmit leprosy, and bedbugs are practically known, from circumstantial evidence, to have been carriers of this disease in some cases.

Other offices of insects are to destroy noxious plants, to act as pollenizers of plants, to act as scavengers, to work over the soil, bringing the subsoil to the surface and passing the earth through their bodies, thereby enriching it with their intestinal secretions; to furnish human food, to produce materials for clothing, such as silk, and to furnish food for such useful animals as birds and fishes.

The knowledge which we at present possess of the great importance to mankind of the insect world has been almost wholly the accumulation of the past century, for the most part of the past thirty years. Thirty years ago our entomological workers were few in number and their work was but little noticed by the masses, except as an outbreak of the Rocky Mountain grasshopper or some similar phenomenon reminded the thoughtless that creatures possessing neither size nor swagger can sometimes force themselves into the full limelight of human attention. Thirty years ago the United States Department of Agriculture carried an entomological staff that would scarcely compare with the present day staffs of several of our experiment stations, and the experiment stations were not then established. A few state entomologists kept lonely vigils in cramped quarters, and maintained their enthusiasm by corresponding with each other and from pure love of the work. At present the Government Bureau of Entomology employs more than 100 scientific investigators and 250 clerical employees. Fifty-one experiment stations scattered through our states, territories and island possessions employ in the aggregate from eighty to ninety entomological workers, besides clerical help, and have considerable equipment in the way of libraries, machinery, etc. The regular appropriation made by the last Congress for the Bureau of Entomology was $184,960, besides an emergency appropriation of $250,000 to be expended under the bureau's direction for suppression of the gypsy moth. The appropriations made by the various state legislatures in support of entomological investigation by state agencies is much more liberal than formerly, New Jersey in some years giving as much as $10,000 for mosquito extermination work alone, and Massachusetts $250,000 to be expended against the gypsy moth.

Following the lead of the United States in this study of insect control, many other countries, in every quarter of the globe and the islands of the sea, have employed entomologists, taking from America as many experienced men as could be persuaded to go at salaries from double to quadruple what they receive at home.

This small but trained army of workers is busy following out the life histories of insects which are injurious, testing the effects of various poisons and insecticides upon both insects and plants, with the aid of mechanics devising machinery suited to insect warfare in garden, field, orchard, forest and city, noting the effects upon insects of meteorological and climatic conditions and changes, and studying the interrelations existing between different species of insects, and between insects, birds and insectivorous animals. Many of our worst insect pests are importations from foreign lands, such as San José scale,

Hessian fly, gypsy moth, brown-tail moth, cotton boll weevil and codling or apple worm. When first introduced these pests, being unmolested and not kept subdued by their natural enemies, which were left behind, often multiply prodigiously and make for themselves unheard of records for destructiveness. In such cases nature's balance is not restored until their old enemies are imported to prey upon them, or until parasitic and predaceous forms, native to their new home, acquire a taste for them. A striking illustration of the benefits which may sometimes be obtained by fighting insects with insects was given by the importation of the Australian lady-bird into California. The cottony cushion scale, a citrus pest, was introduced into California from Australia about 1868. By 1886 it had spread to eight different countries, and three years later so much of the orange territory had become infested and so helpless were our entomologists and the citrus producers before its rapid march that the entire citrus industry in the state seemed doomed, and many of the growers had already abandoned or were preparing to abandon their business when the advent of the lady-bird happily restored confidence and the fluted scale has not been a very important factor in California orange culture since. Something like 127 lady-beetles were received from Australia and, from the progeny of these bugs alone, California was completely stocked and practically cleared of the scale in about eighteen months. A few years since, while entomologist of the Florida Experiment Station, the writer had the pleasure of repeating this California exploit in the Florida orange groves, where the same scale had become accidentally established. Another parasite brought over from Australia at the same time as the lady-bird has cleared many of the olive groves of California of the black scale and has been a great factor in preventing headway by this pest. At present the United States Bureau of Entomology, in conjunction with the Massachusetts authorities, is making importations of parasites and predaceous insects for trial against the gypsy and brown-tail moths on the largest scale that has ever been undertaken. Hundreds of thousands of host insects, containing parasites, have been brought each year from a large part of their geographic range. More than forty species of parasites have thus been brought over, bred and liberated. Several of them have certainly established themselves in New England and there seems to be every reason to believe that speedy success will be reached. As a summary of the general teaching of the paper, I cannot do better than close with the following quotation from the acute writings of our government's entomological chief, Dr. L. O. Howard:

"Man is but one of the forms of life struggling for existence, at con-

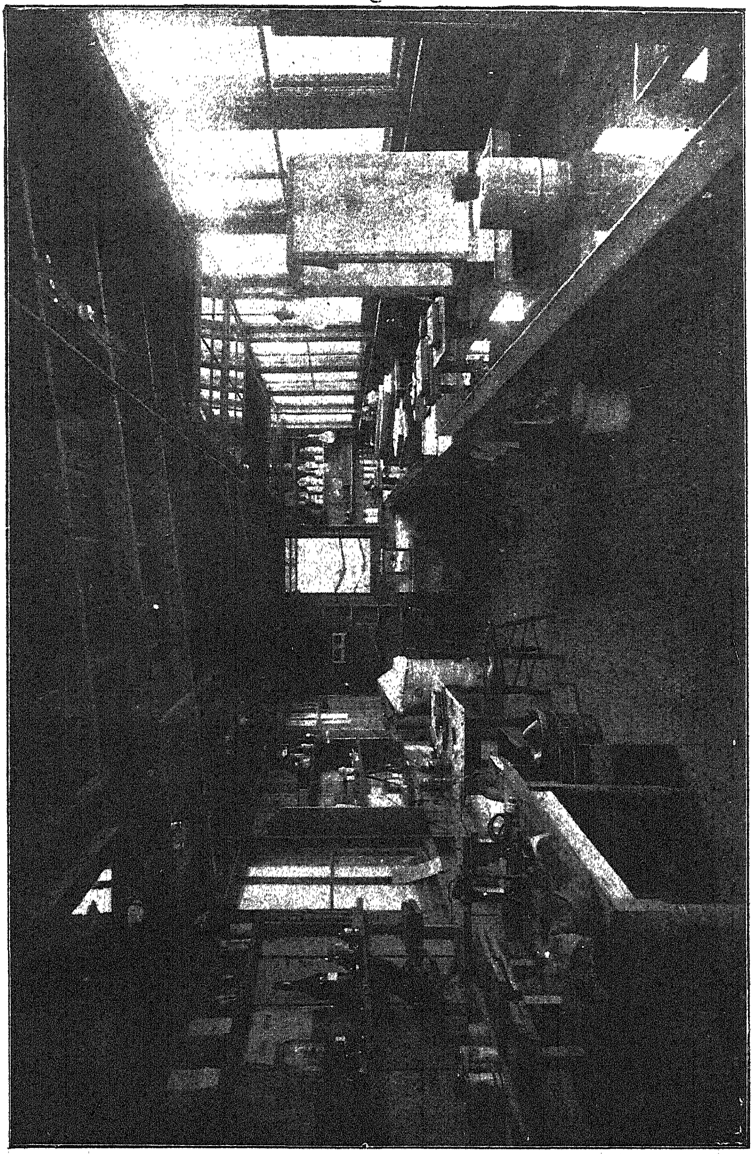
tinual warfare with surrounding forms, but by virtue of his surpassing intelligence—itself as gradually evolved as have been the physical characteristics of any given species—he has overrun the earth, has accommodated himself to the most unnatural environments; he has dominated all other species in nature; he has turned to his own uses and encouraged or hastened the evolution of species useful to him or of useful qualities in such species; he has wiped out of existence certain inimical forms, and is gaining the control of others. He is the dominant type, and types whose existence and methods of life are opposed to his interests are being pushed to the wall. It is the culmination of a history which has many times repeated itself in past ages. The struggle of other forms of life to accommodate themselves to the conditions brought about by the rapid development of the dominant type is one of the most interesting fields of study open to the biologist today. It would seem as if, in man's efforts to make the face of the earth his own, all the complicated elements of life were arrayed against him, and the great and ultimate result of the labor of the biologist in his study of the relations of the different forms of life and the laws which govern their development will be to bring about the absolute control of all other life by man. Thus it is not only the economic worker who looks for immediate results of a practical kind from his labor—the scientific agriculturist, the horticulturist, the economic zoologist, the medical bacteriologist—who should command the respect of even the practical minded man, but the biologist in whatever field, however restricted it may be, whether he is working towards the understanding of broad principles and general laws or whether in some narrow corner of research he is accumulating material which will help ultimately to lead to wider understandings—all are working helpfully and practically towards the perfect well being of the human race."

MEASURES SUGGESTED AGAINST THE ARGENTINE ANT AS A HOUSEHOLD PEST

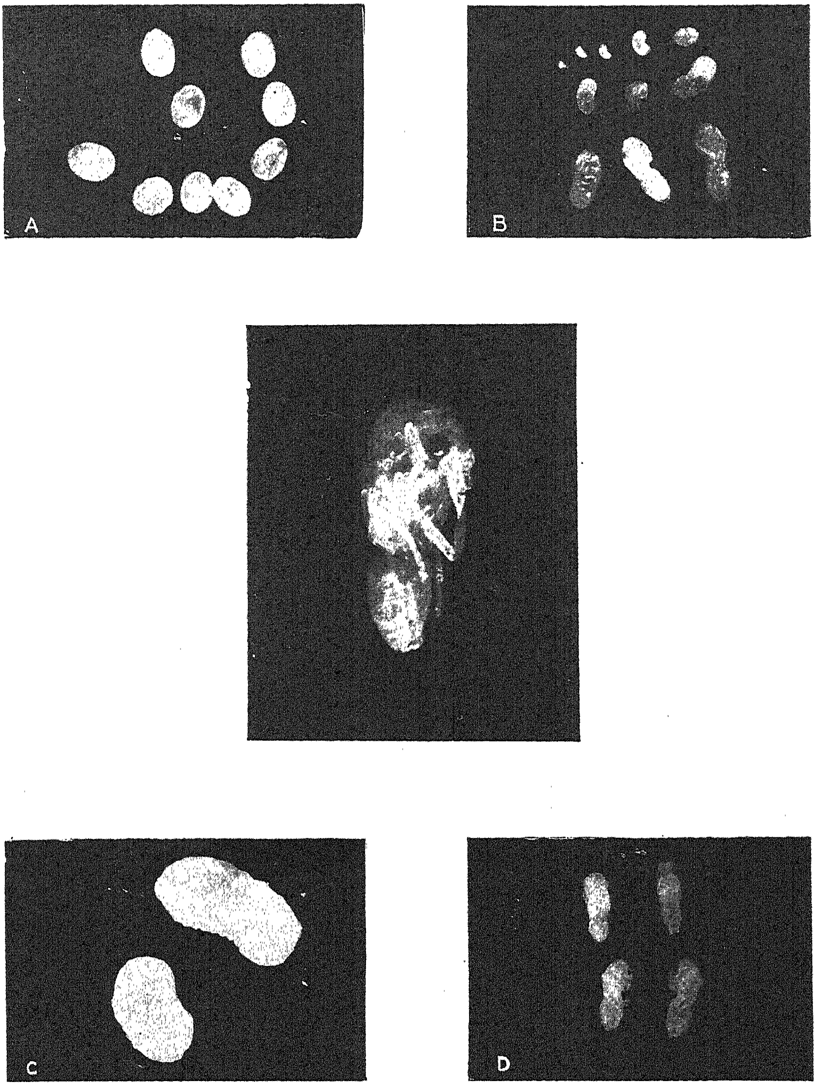
By Wilmon Newell, *Baton Rouge, La.*

The preliminary investigation of an injurious insect usually suggests measures by which temporary relief from its ravages may be secured, even though many years of tedious work and study may be required for the development of really satisfactory and economical methods of control. To this rule the Argentine ant, *Iridomyrmex humilis* Mayr., has proven no exception. Our study of this species

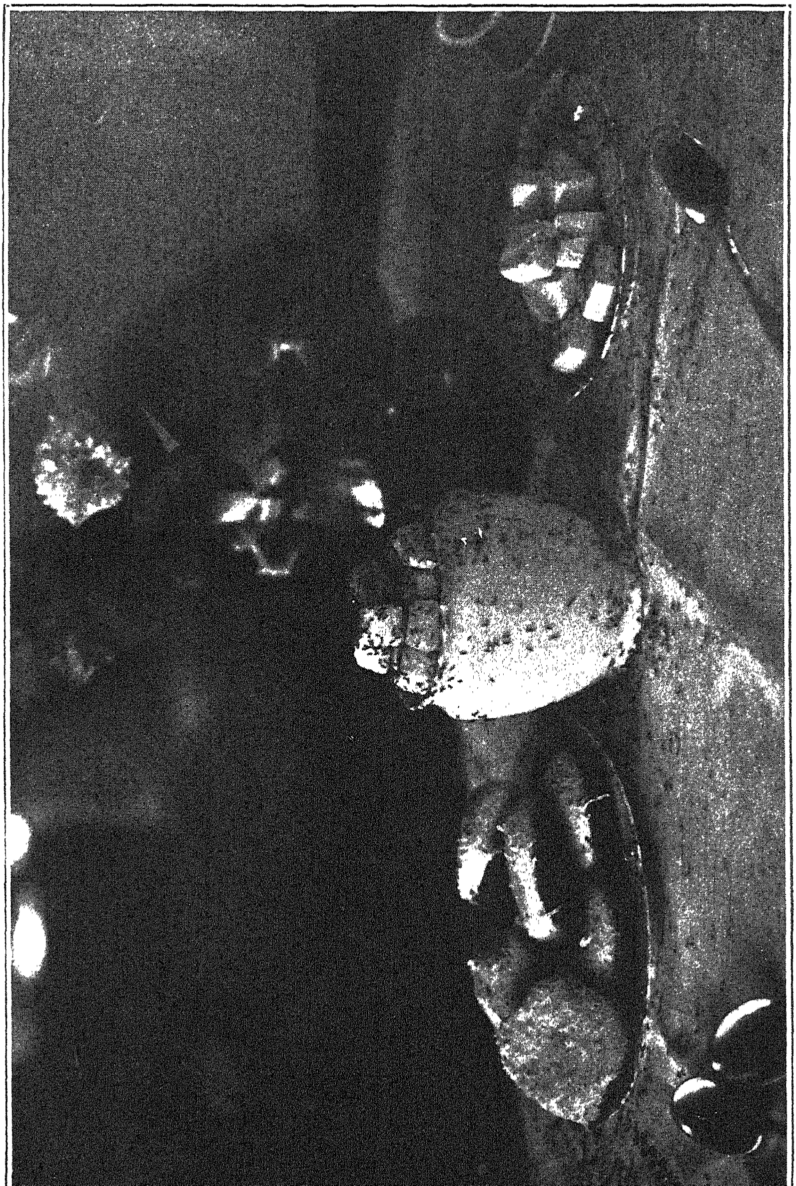
A small colony of Argentine ants in their formicary (x 1.4). The queen is seen near the center of the picture and a short distance to her left can be seen a worker carrying a small mass of eggs (from photo by T. C. Barber).



"Formicarium," or special insectary, constructed and equipped by the author for studying the Argentine ant. Cages and formicaries, resting in large trays of running water, are seen to the right and at the further end is seen the combined hygrograph and thermograph, which makes a continuous record of the humidity and temperature in the room.



Immature stages of the Argentine ant: A, eggs deposited by queen, enlarged 20 times; B, worker larvæ and pupæ in various stages of development; C, full grown worker larvæ, enlarged 12 times; D, worker pupæ, enlarged 5 times; central photo is that of a male pupa, enlarged 11 times.



The unbidden guests. Argentine ants on a lunch table.

during twenty-four hours, the colony would be no weaker at the end of the period than at the beginning, for the workers destroyed would be equaled or exceeded in number by the workers reaching maturity during the same period within the colony. The futility of methods which do not destroy the colonies, and particularly the queens, is therefore self-evident.

Winter Trapping

Reference was made in a preceding article[2] to the tendency shown by the Argentine ant colonies to segregate or combine in the autumn, preparatory to passing the winter as large colonies, containing thousands of workers and larvæ and dozens, or even hundreds, of queens. These large colonies seek their domicile in well-protected locations favorable for passing the winter. Warm situations are particularly attractive to them. This habit we utilize in the following manner: About the first of October an ordinary dry goods box, about 2x2x3 feet, is filled with cotton seed and straw, or other porous vegetable material, and placed near the center of the ordinary city lot or garden. The top of the box is left exposed to the weather so that the contents will become moist and commence to decay. As decay proceeds the center of the mass becomes very warm and the whole presents a nesting situation so attractive to the ants that practically all colonies within a radius of thirty or forty yards take up their abode in it as cool weather approaches. On warm days the ants will be found near the outside of the mass and on cold days nearer the center, as they move inward towards the warmest part until the desired temperature is reached. During January the cracks in the box are closed tightly, the top covered with a waterproof canvas and a pound or two of carbon bisulphide poured into the box to destroy the colony.

A box of this kind, shown in the accompanying illustration, was prepared in the fall of 1907, not for the special purpose of destroying ants, but for making a small amount of compost for a garden bed. The ants moved into it in such large numbers that the opportunity for destroying them at once presented itself. During the winter this immense colony was examined from time to time and upwards of 150 fertile queens taken from it, together with eggs, larvæ and pupæ by the cupful as wanted. A conservative estimate placed the number of fertile queens in the colony at upwards of 1,000. The colony in question was not destroyed, as the writer kept it under observation to see "what would happen." He found out. Early in March, 1908, the ants migrated from the box in small colonies and established themselves over the entire premises, with the result that the place was

[2]Journal of Economic Entomology, II, p. 191.

heavily overrun with them and they proved themselves intolerable nuisances during the ensuing summer.

The experiment was repeated on the same premises (a city lot about 40 by 100 feet) in the fall of 1908, but the colony was destroyed with bisulphide during February, 1909. The difference in the infestation of the premises this season, as compared to last, is remarkable.

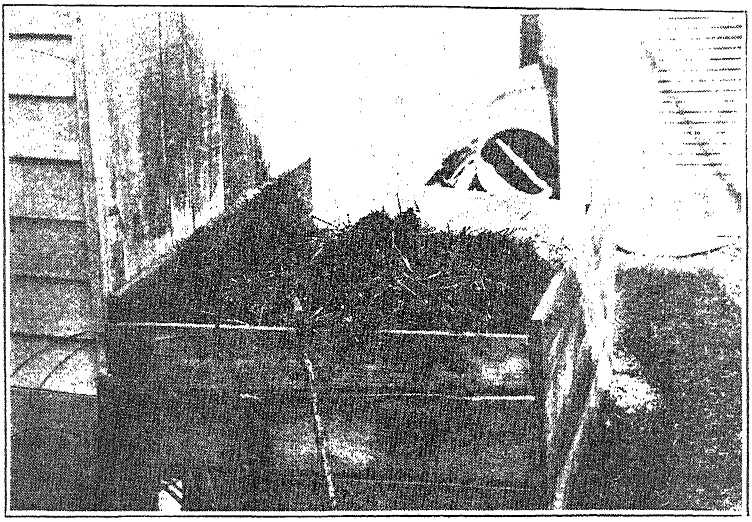


Fig. 5.—"Winter trap" for the destruction of Argentine ant colonies. The heat of the decaying vegetation attracts the colonies to the box, where they are destroyed by fumigation with bisulphide of carbon.

Up to the present writing (July 25th) their presence has hardly been noticed, many days elapsing at a time without a single ant being seen inside the residence. At the present time, however, the place is again being occupied by colonies working their way into the premises from adjoining lots, where no steps were taken for their destruction.

So effective has this winter trapping appeared to be that we fully believe that if it were carried out uniformly, by the residents of several or more contiguous city blocks acting in coöperation, few if any other measures would be necessary to hold the pest in reasonable check.

Destruction of Colonies in Summer

Much can be accomplished by destruction of colonies during the summer months, but owing to the relatively small size of the colonies and their occurrence in every conceivable situation,[3] steady and per-

[3]Following are some of the situations in which colonies of the Argentine ants

sistent effort is necessary to bring about anything like satisfactory control.

Colonies located in the ground can be destroyed by the well known method of pouring bisulphide of carbon into the nest through an opening made with a sharp stick and then covering the nest well with moist earth.

We have tested the solution of potassium cyanide, one ounce to the gallon of water, used by Mr. R. S. Woglum of the Bureau of Entomology, for destroying other species of ants in California, but have not been satisfied with the results. In one experiment a fairly heavy spraying of the ground with the cyanide solution failed to kill larvæ and mature forms one half inch below the surface. As the underground chambers not infrequently extend to a depth of 12 or 14 inches, an immense amount of this solution would be necessary for effective work.

Crude oil as it comes from the oil wells, usually known in the South as "Beaumont oil," is a valuable auxiliary in the fight against the ants. It is certain death to any insect it touches, but being also fatal to vegetation, its use is principally restricted to the destruction of colonies which are exposed by the overturning of boards, boxes, piles of rubbish, leaves, etc. Colonies of the ant are exposed when least expected and in unthought of places. One must therefore keep the oil handy, ready for immediate application to the nests whenever they are found. We have found the small compressed-air sprayers, which are readily carried about and which are always ready, very convenient for use in destroying these summer colonies. Crude oil, poured liberally upon the ground where a colony has its underground abode, will gradually work its way through the galleries and either destroy the entire colony or destroy the major portion of it while the balance betakes itself to a less objectionable location.

In lieu of the crude oil, hot water, kerosene, Kreso, Zenoleum, creosote or other powerful liquid insecticides may be used for destruction

have been found: In the earth, under boards, beneath shingles on roofs, in rolls of wrapping paper, under rugs, in foundations, between walls of dwellings, in attics, under bark of trees, in manure piles and compost heaps, in tall grass, in bean bushes, in bags of sugar, in the tops of trees, in flower pots, in the veneer covering of metal cans, in garbage cans, in piles of brick and stove wood, between doors and their thresholds, in bee hives with colonies of bees, under discarded roofing tin, in various places on steamboats, around the roots of cotton and other growing crops, in the cinder ballast of railroad tracks, in decaying logs, under brick and concrete pavements, within porch pillars of wood, in hard clay roadways, in old clothes, under street car tracks, in greenhouse benches, inside the husks of roasting ears and in old birds' nests.

of the colonies that may be exposed, but all of them are more expensive than the crude oil.

Colonies which are located in inaccessible situations can, by patient work, be coaxed into domiciles where they may be destroyed. Decaying wood is *par excellence* the favorite nesting place of the species. Coupled with this is the habit repeatedly shown of colonies moving into close proximity to any constant source of food. Many colonies are therefore effectively destroyed by placing pieces of decaying logs here and there in shaded locations and placing beside each one a small jar of honey or sugar, its top covered with wire cloth to prevent the contents being removed by bees and other large insects. This attractive nesting place is shortly occupied by a colony of the ants and the latter is then destroyed *in toto* by submerging the entire block of wood in a pail or tub of boiling hot water, after which it is "reset" to attract another colony.

These measures, involving as they do considerable labor and time, are not likely to be applicable in orchards or over large cultivated areas, but on the small city lot where protection from the ants must be secured or the premises vacated, they are far better than no methods at all.

Poisoning the Ants

As pointed out above, the use of poisons cannot afford satisfactory relief unless the poison used is one which will destroy larvæ and workers, as well as queens, within the colony. To meet this requirement the poison must be fatal but must act so slowly when contained within the insect stomach that it will not kill the foraging workers ere they can transport it to the nest and there deliver it to other members of the colony. Our efforts to secure a poison meeting this requirement have met with only indifferent success, the following possessing some little merit in this direction: One part, by measure, of paste lead arsenate is thoroughly ground with pestle and mortar with twice its bulk of pulverized sugar. This forms a liquid which in turn is mixed with an equal bulk of honey and the whole mass thoroughly ground and mixed. Another mixture, nearly as good, is made by thoroughly mixing one part of *powdered* arsenate of lead with five or six parts of honey. This is placed in small dishes where the workers can help themselves and when, after a few days, they cease to work on it, it is removed to a new location. When poison of this character is moved even a few inches, the ants seem not to recognize it as dangerous and attack it with renewed energy. In an experiment with the mixture of honey and powdered arsenate of lead a colony was permitted to choose as it pleased from the poisonous mixture and from non-poisoned

honey and other food, with the result that the mortality within the colony slightly exceeded the rate of reproduction and the entire colony became extinct in forty-four days after the beginning of the experiment.

When not supplemented by other measures, such as mechanical destruction of the colonies, the use of these mixtures will not be found satisfactory unless used steadily and persistently for a long period.

Sweetened preparations of soluble arsenic are of little direct use as they kill the majority of the foraging workers taking them and little, if any, of the poison reaches the colony proper. Such preparations are, however, useful in driving the ants away from limited areas within buildings, as described below.

Repellents

Various schemes and substances have been tested for the purpose of keeping the ants off tables, away from food stuffs and out of buildings and rooms, but the only ones worthy of mention are the corrosive sublimate "ant tape" and the sweetened solutions of white arsenic.

Ant Tape

Ants of this (and of some other) species will not cross cotton cloth or tape which has been thoroughly soaked in a saturated water solution of corrosive sublimate and then dried. In practice the tape is tacked around table legs, around edges of shelves, etc., to protect sugar, candy, meat, syrup, and similar materials. Our method of preparation is to first prepare a solution of the corrosive sublimate by heating the sublimate and water in a *porcelain or granite ware* vessel until the maximum amount is dissolved. This solution is allowed to cool to ordinary temperatures, then filtered, and ordinary cotton or binding tape soaked in the filtrate for several hours. The tape is removed and pinned up on a wall to dry, after which it is ready for use. It is very important that no iron, tin or steel come in contact with the solution or with the tape itself after being made. In actual test we have found the tape thus prepared to successfully repel the ants for eleven months without being renewed.

For several years "ant tapes" and "ant papers" of this character have been on sale in New Orleans and other southern cities in the infested region. The ant paper is usually prepared by painting a sheet of paper with corrosive sublimate solution or some mixture containing it. Most of the commercial ant tapes and papers are carelessly made and hence are often found next to useless or are effective for but a short time.

The use of corrosive sublimate for this purpose seems to be mentioned rarely in entomological writings, but there is ample evidence that it has been used in this manner for at least two generations. Prof. C. W. Hutson, formerly professor of history in the Agricultural and Mechanical College of Texas, informs the writer that his father, Wm. F. Hutson, who resided in the vicinity of Beaufort, S. C., was accustomed to soak cotton strings in corrosive sublimate and use them to protect barrels and other places containing sugar from the native ants as long ago as 1850. Professor Hutson does not know whether this knowledge originated with his father or whether it had been handed down from preceding generations, but the instance is interesting in showing how knowledge of much practical value may escape "official" notice indefinitely.

Sweetened Arsenical Solutions

Our experiments have shown that solutions of sugar or molasses containing a small percentage of arsenic can be used to "drive" the ants from a room which the foragers persist in visiting. The best solution of this kind is made as follows: White arsenic, ½ gram; cane sugar, 20 grams; water, 100 cc.

The arsenic is dissolved in a portion of the water by boiling and the sugar dissolved in the remaining portion. The two solutions are then mixed and sufficient water added to compensate for the evaporation. Fruit juice or other inert coloring matter may be added to give warning of its dangerous nature. Placed in small dishes beneath cupboards, refrigerators,[4] etc., the workers attack it vigorously for a few hours, then in decreasing numbers, and after three or four days forsake its vicinity entirely. By placing a small dish of this poisonous mixture beside a jar of honey, without other protection, we have forced the ants to entirely abandon the honey after having worked vigorously on it for several days.

Prof. C. P. Lounsbury, Entomologist of the Department of Agriculture at Cape Town, South Africa, writes us that considerable success has been attained in repelling the Argentine ants from residences there by the use of very similar mixtures. Those most frequently used by Professor Lounsbury are Cooper's Dip and Golden Syrup, equal parts, and a mixture of marmalade, sugar and arsenite of soda.

Various compounds of sugar and arsenic under such suggestive names as "Thunderboldt," "Great American Ant Poison," etc., are

[4]The temperature of the average refrigerator is not low enough to discourage the ants in the least. Fresh meat, lard, fruits, etc., are as subject to attack as if they were in a temperature of from 70 to 80 degrees.

on sale in the ant infested region, and while extravagant claims are made for them by their manufacturers, they are of little value aside from use as repellents, in which classification they should properly be placed. The prices charged for such poisons are usually out of all proportion to their real value.

Owing to the dangerous nature of the ant tapes and arsenical poisons, it is our custom to advise correspondents that these be prepared by pharmacists rather than by the inexperienced and labelled with the proper precautions and directions for use.

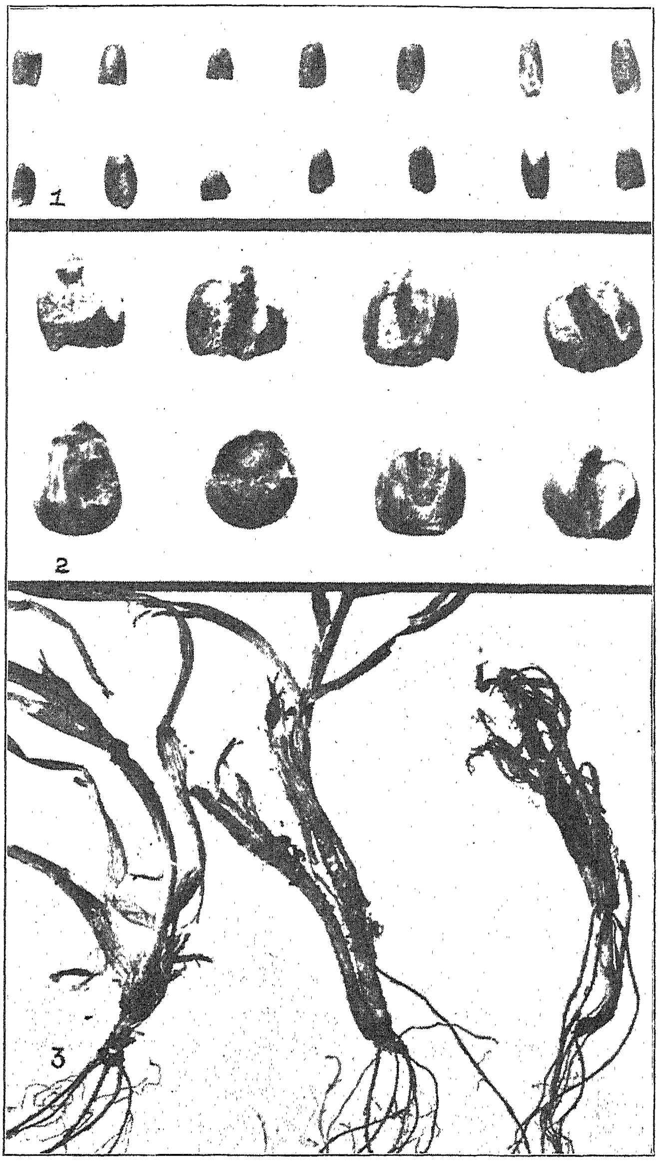
Baton Rouge, La., July 25, 1909.

ELEODES AS AN ENEMY OF PLANTED GRAIN

By Myron H. Swenk, *Assistant State Entomologist, Lincoln, Neb.*

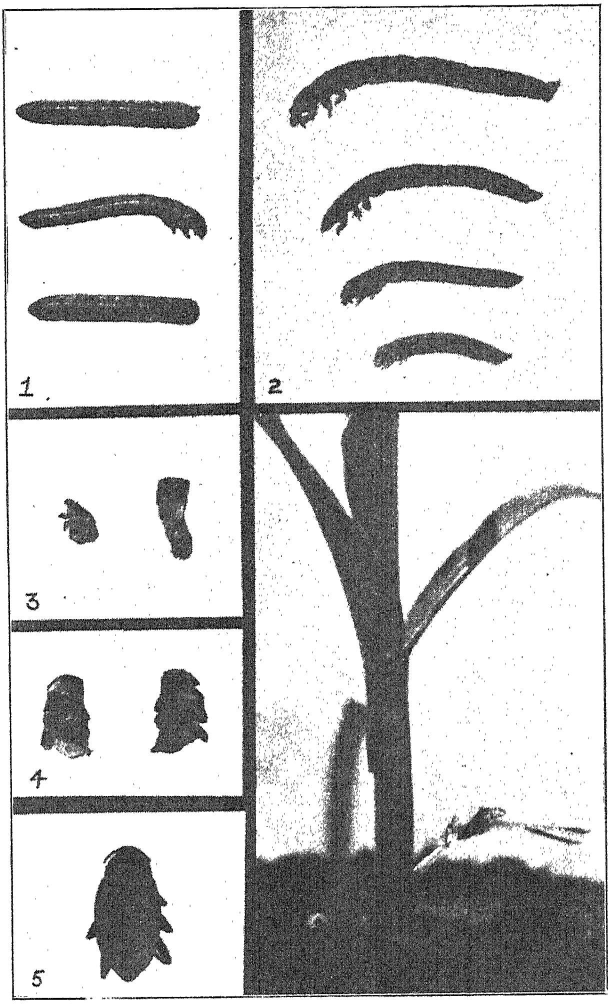
Within the past year a new insect enemy of planted grain has come to our notice in the form of a tenebrionid beetle larva, which destroys the seed in the ground before it can germinate. The work with this insect having been continued for less than a year, the results are as yet necessarily somewhat fragmentary, but similar depredations by allied species on the Pacific coast, which I am informed by Professor F. M. Webster are now demanding his attention, seem to make desirable a preliminary report at this time. Our attention was first drawn to this new pest by a letter received under date of September 22, 1908, from a correspondent at Beaver City in Furnas County, Nebraska, complaining of numbers of these larvæ in the soil which were destroying the planted wheat in that vicinity, and a specimen of the larva concerned accompanied the letter. A request to our correspondent for more specific and detailed information elicited the reply that the larvæ were abundant in the wheat fields north of the town, three or four of them to the foot in the drill rows, and in two fields he knew of were doing a great deal of damage, so much so that it would be impossible to obtain a stand of wheat. The situation was apparently serious enough to warrant personal investigation, and accordingly on the 29th of September the writer visited the locality to look over the infested fields.

The first field visited was one located three miles north of town, where the larvæ had been originally discovered and reported upon. This field had been in corn the previous year. The larvæ were found abundantly in every part of the field, and about 60 per cent. of the planted seed, judging from several hundred kernels collected in the



INJURY TO WHEAT AND CORN BY ELEODES OPACA.

1, seed wheat taken from drill rows showing type and extent of injury to the planted kernels; 2, similar injury to corn when placed in rearing cages; 3, injury to bases of growing wheat plants. All slightly enlarged (original).



STAGES OF ELEODES OPACA.

1, full grown larva of *Eleodes opaca*, dorsal, lateral and ventral aspects; 2, larvæ of *E. opaca* (lower figures) contrasted with a larger apparently distinct species found in similar situations (two upper figures); 3, shed larval skins of *E. opaca;* 4, pupa of same; 5, imago (♀) of same; 6, beetle on young corn plant. All about natural size except 6 which is reduced one-half (original).

drill rows, had been badly gnawed so that they could never germinate. Many kernels were almost entirely eaten up, as the accompanying illustration shows. As our correspondent had written, four or five of these larvæ were to be found in every foot of the drill row, and in a half hour over forty of them were picked up. Another field planted in ground just broken from sod was almost as severely infested. In still another field growing up to volunteer wheat the larvæ were present abundantly. In fact this condition seemed to be general in all the fields over the whole region, extending at least over the southern half of Furnas County, as over a dozen farmers of the vicinity with whom the writer spoke testified that their fields were infested similarly to those examined. It was necessary with one field of ninety acres in winter wheat to completely resow forty acres. At the prevailing price of wheat this was so serious an item that some of the oldest wheat growers would not replant, but decided to allow the ground to lay over until they could plant corn in the spring.

While searching for larvæ in the drill rows a solitary specimen of *Eleodes opaca* Say was caught as it crawled sluggishly over the ground. The owner of the field immediately identified this beetle as the same as certain "black bugs" concerning which he had just been inquiring, great numbers of which had swarmed in the fields just after harvest (late July), and other farmers corroborated this testimony from experience in their own fields. In fact we had received reports of this occurrence, accompanied by specimens from McCook, in the same general region, at the time. So abundant were the beetles on this farm that the owner became alarmed and tried poisoning them, but with what success he did not fully ascertain. On hot days up to the latter part of October the beetles were still in evidence.

After a careful examination the larvæ were identified as apparently belonging to one of our tenebrionid beetles, probably an *Eleodes*, and specimens were sent to Prof. F. M. Webster, who corroborated this determination. The abundance of the beetles of *Eleodes opaca* in the fields during the summer and the great abundance of these certainly allied larvæ in the same fields later in the year justified our tentative reference of the new pest to that species, which identification has been amply verified by subsequent rearings of the larvæ.

Following my visit to Beaver City there was a heavy rain in the vicinity, and immediately after this rain the larvæ were found "crawling all over the top of the ground by the thousand," according to our correspondent, who had agreed to keep the larvæ under observation for us, but they returned to a slight depth after the ground had dried out somewhat. Following this rain the injuries distinctly

abated, the larvæ seemingly not injuring the germinated wheat or sprouts. Though no corn fields were examined by the writen while at Beaver City, farmers stated that some of these larvæ were present there also, even in one field which had not been cropped in wheat for five years. Furthermore, in our breeding cages the larvæ ate corn kernels greedily, while two of them were taken from a box containing several ears of corn shipped in from Gothenburg, Nebraska, as samples of corn-ear worm injury. Presumably they had located themselves in the tips of the fallen ears and in transit had made their way out again. Accordingly it will not be surprising if this insect is found to be at times of serious injury to planted corn also.

On April 14, 1909, Mr. C. H. Gable of this office visited the same locality and found that the stand was so thin that most of the fields were being disked preparatory to planting a new crop. The larvæ were not in the drill rows, as a most careful examination disclosed, but were abundant just underneath the surface in the little piles of loose, dry drifted soil, in old corn fields about the half rotted stubs, sometimes as many as thirty about a single stub. They were also feeding upon the crowns of the wheat plants to a small extent, especially where these were adjacent to the drifts wherein the larvæ were congregated. Mr. Gable found larvæ actually engaged in this injury, the exact character and extent of which is shown in the accompanying illustration. It is possible that these larvæ do not descend to a great depth in the winter and that they have considerable resistance to cold is shown by an accident which befell one of our breeding cages. On the night of January 28 a storm blew in one of the windows and dashed the cage to the floor, spilling the contents. This happened at about 10 p. m. and for twelve hours they were exposed to a sweeping wind of from fifty-nine to seventy-two miles an hour at a temperature hovering about zero. The next morning they were gathered up and placed in a warm room and out of eleven thus gathered eight recovered activity and burrowed under the ground again.

In our breeding cages the first pupa was found on the morning of May 28, when a larva which had come to the surface and lay there quietly for three days pupated over night. Twelve days later, June 8, this pupa had developed into a beetle. Another larva, which came to the surface of the ground May 28, had pupated May 31 and transformed to the imago June 10. Other larvæ pupated down to several inches in the earth, the last pupa being secured July 19. Almost simultaneously with the emergence of the beetles in the breeding cages they began appearing in numbers in the fields, and under date of June 17 our correspondent at Beaver City reported large numbers of them

crawling about over the ground. During the present summer (1909) they have been as abundant as last year, and under date of July 31 our correspondent reports them in undiminshed numbers but tending to burrow out of sight in the ground, probably for purposes of oviposition. A female was dissected on August 10, the ovaries of which contained seven eggs. These eggs were oval, the chorion pure creamy white and without sculpture and measured 1.5–1.7 mm. x .8 to .85 mm. Other gravid females placed in a breeding cage with the bottom shallowly covered with earth on August 9 soon deposited eggs in the soil and when this soil was re-examined August 30 newly hatched living larvæ as well as larger dead and dried larvæ, evidently hatched several days previously, were found, apparently fixing the hatching period at something less than three weeks. The newly hatched larva is soft, pure white in color and about 2.5 mm. long, but soon darkens and assumes its corneous integument.

The fully grown larvæ of *Eleodes opaca* average about 16 mm. long, are yellowish in color and have a very striking general resemblance to wireworms because of their heavily chitinized elongate, cylindrical and ventrally flattened bodies. The body surface is glabrous, except on the ventral surface of the head and thorax, on the legs and on the pygidium. The larva agrees very closely with Blaisdell's figures and description of the larva of *Eleodes dentipes*[1] but has several minor points of distinction, *e. g.*, the anterior legs are quite spineless, but the intermediate and posterior legs are abundantly spinose, the pygidium is subtriangular, with apex broadly rounded and bearing two small spines, while on each lateral margin may be found six or seven minute blunt tubercles, the whole of the segment bearing scattered long bristles. The pupa is 16 mm. long x 3.5 mm. wide, creamy white, darker on the head and legs, with the antennæ blackish, and in general structure agrees quite well with Blaisdell's figures and description of the pupa of *Eleodes clavicornis*, but the third and fourth ventral segments are transverse apically like the others, the small segment at base of terminal cerci is but feebly emarginate, the emargination of the lateral processes of segments 2–6 are of a radically different and more complex pattern, while the pronotum has but a single row of closely set lateral setæ, the post-apical and antebasal being very feeble or lacking, etc. The image is well known and has been quite adequately described elsewhere.

The success of our breeding experiments was greatly detracted by the presence among the larvæ of what was apparently a bacterial disease. A small dark red spot would appear somewhere upon the

[1]Blaisdell, Revision of the Eleodiini of the United States, p. 497–499 (1909).

body sutures, usually back of the head or on the terminal abdominal segments, which in a few days would extend nearly completely around the body and within a short time after this the larva would be dead. Three different lots of larvæ, secured at various times and placed in different cages all finally succumbed to this disease. The living larvæ took advantage of the presence of the dead ones by eating them, and several specimens were taken from the cages in a partially devoured condition. The larvæ shun light and if taken out and released dig back into the earth with great rapidity. When first disturbed they almost invariably feign death and after lying motionless for a time suddenly dig into the earth or run away with frantic energy. The pupæ are very sensitive and wriggle and twist vigorously if disturbed in any way. The beetles fed voraciously upon corn leaves in our breeding cages, gnawing large longitudinal holes in them in a short time.

While *Eleodes opaca* is undoubtedly the species responsible for most of the injury to planted grain in this state, frequently a larva apparently belonging to one of our several other species is found in the same situations as *opaca*. In Nebraska we have *E. tricostata* Say, *E. obscura* Say, *E. suturalis* Say, *E. pimeliodes* Mann., and *E. hispilabris* Say extending over practically the entire state, *E. opaca* Say, *E. obsoleta* Say and *E. extricata* Say occurring in the central and western portions, and *E. nigrina* Lec. occurring in the extreme northwestern part of the state, and some of these species undoubtedly occasionally attack planted grain. Other related genera may also take some part, as specimens of *Embaphion muricatum* Say occurred this year in company with the swarms of *Eleodes opaca* in the infested fields.

DEMONSTRATION WORK IN ECONOMIC ENTOMOLOGY

By Franklin Sherman, Jr., *Entomologist, State Dept. of Agriculture, Raleigh, N. C.*

Probably every entomologist feels that the importance of his work is not properly appreciated by his public. We find that the public does not understand an entomological emergency when it exists,—that it does not always take us at our word when we say that certain treatments are effective, practical and necessary,—or if the public listens to our recommendations at all it is only with indifference, to go its way in the old lines.

To be sure there is in every state a progressive element (larger in some states than in others, but always in the *minority*) that keeps

abreast of modern discovery and practice,—but is this element really the one most important to reach? It is able to take care of itself and is in the minority. It is doubtful therefore whether work conducted especially for this more intelligent and progressive element really results in that "greatest good to the greatest number," which is often accepted as a test of real utility. We take it that with many of us the question of reaching the great mass of our constituents *effectively*, to show them that economic entomology really has something of value to offer them, is a matter to which we could profitably give attention, and upon which we would be justified in making considerable expenditures.

And let us state emphatically that we would not advocate popular demonstration work to the exclusion of investigation,—not at all. Some of us are so favored with appropriations that we can carry on both lines at once. Those of us who, like myself, are not so fortunate might plan to set aside a few weeks of each year for work of this sort. We are doing this in North Carolina and it is working well.

On assuming the duties here some years ago the writer found that very few fruit-growers were spraying their trees, even when known to be infested with the San José scale, and spraying to control codling moth was almost unknown. These men knew no such science as entomology and acknowledged no indebtedness to its teachings. We soon found that the bulletins circulated but little among our orchardists and that the *average* man gives but little attention to such bulletins as he receives.

We have taken up the spraying of apple trees with poisoned Bordeaux as the line of work in which we could most certainly assure our people of profitable returns for their labor,—also for the reason that its results show up strikingly and convincingly, and is therefore a sort of advertisement of itself.

During 1908 we conducted apple-spraying demonstrations in five different counties in the apple-growing section, one in each county. The demonstrations were widely advertised in advance. The party carried a bucket outfit, as used in small orchards, and a complete barrel outfit with two leads of hose, extension rods, double nozzles, etc., such as is the standard for small commercial orchards. Three or four trees only were treated at each place, and one of these was sprayed on only one side. The poisoned Bordeaux was made up in the presence of the audience and then sprayed on the trees, every step being explained. We used Paris Green as the poison for the reason that it is more available to the average man than arsenate of lead. This series of public demonstrations was given during February before the buds began to

open, and at each place we explained that two more treatments with the same material would be given to the same trees. The second treatments were given just after the blossoms fell,—April 16th to 23d in this case—and the third treatment was given from two to three weeks later.

ORCHARD DEMONSTRATION INSTITUTE

A PRACTICAL DEMONSTRATION OF PRUNING AND SPRAYING WILL BE GIVEN IN THE ORCHARD OF MR. L. W. HOLT ON R. F. D. No. 7, TWO MILES SOUTH OF

BURLINGTON

Tuesday, February 9, '09

The object of this meeting is to bring together those interested in Fruit-growing, in order to give Demonstrations of modern methods of pruning and spraying fruit-trees, to encourage the growing of good crops of fruit and combat insect pests and diseases.

The North Carolina State Department of Agriculture will send S. B. Shaw, Assistant Horticulturist, and Z. P. Metcalf, Assistant Entomologist, suitably equipped with instruments and apparatus to conduct these demonstrations.

All farmers, and especially those interested in Fruit-growing, are invited and urged to come and ask questions and join in the discussions.
The demonstrations will begin at 10:30 A. M.

W. A. GRAHAM,
Commissioner of Agriculture.

Fig. 6.—Copy (reduced) of poster used in advertising spraying demonstrations in North Carolina (1909).

We felt that we had carried our work to the very doors of the growers, and yet the attendance and interest was in some cases very disappointing. More than once we went to work at the appointed hour with only two or three spectators. In one or two cases even the owners whose trees were treated seemed rather indifferent when the work began. In two or three places the attendance was satisfactory. The critical and the faint-hearted could have easily declared the demonstration work a failure and with good show of reason.

But by midsummer the treatments began to tell. We requested reports from all five growers in mid-July, and *every one* reported a distinct advantage in favor of the sprayed trees. (Of course this is nothing new to the readers of this JOURNAL, but it *meant something* to these men!) Even the sprayed half tree showed its superiority in every case over the unsprayed half of the same tree. A second report was requested in October and again in *every case* the grower reported that the prospects of mid-summer were more than justified, that

Spraying demonstrations, 1909, in North Carolina, showing the audiences that gathered at three of the meetings.

the foliage was healthier, the fruit better, and in better condition for winter keeping, and several of these men who had never seen a sprayed tree before in their lives concluded their reports like this, which is quoted verbatim: "I will buy a large spraying outfit and will spray all my trees next season."

But still only a *few* had been reached. It remained to write up a brief readable account of the work, including the favorable reports of the growers, and to send it *to the people who ought to be interested.* For several years we have kept up an inquiry into orchard conditions by means of circular letter and blanks, and now have a list of about 1,500 names, representing about 500,000 apple trees in commercial orchards. This then is a *live list of real fruit-growers.* This little ten-page circular on "Apple Spraying Demonstrations, 1908" (Circular No. 24 of this office) was sent to this list, and we venture the guess that few, if any, of the copies were thrown away, at least until they had been read from beginning to end. Here are a few quotations from that circular:

> "Spraying must come to be the *regular* practice of the *majority* of our growers and not practised regularly by an insignificant number and trified with spasmodically by a few more. . . . Just as soon as our growers learn this lesson and make it a vital part of their practice they will find fruit-growing profitable, but not before. For your own sakes *study* this spraying business and *get to work at it.* . . . It is likely that similar demonstrations will be given in 1909. . . . We hope that the interested fruit-growers will *be there*, and then go home and *practise* what they learn."

The spraying demonstrations for 1909 are now completed and we await the harvest with confidence. We enlarged this season to twelve demonstrations, each in a different county and all in counties not touched last year.

And now, after the final results of last year have been published and distributed (*among those interested*), we are getting the *real* results that we have been after. We are reaching, and reaching effectively, the actual *majority* of the fruit-growers in the neighborhoods where the demonstrations are given. They are *all* becoming acquainted with spraying methods, and *many* of them have already bought outfits and applied to us for directions for the work. A few incidents will be of interest. Soon after our demonstration at Burlington a man (not a commercial fruit-grower) who attended was in my office and said he felt that he personally profited not less than $10 by what he learned,

and he went about twenty miles to attend the meeting. At Greensboro there was an attendance of nearly one hundred men, *there for business*, and in less than a week afterward every hardware firm in the town had sold every spray-pump in stock and many more good outfits were ordered from the makers. At Mocksville there was one man who came nearly forty miles by rail for the one purpose of attending the meeting. Concerning that same meeting Mr. J. D. Hodges, in whose orchard the work was done and who is also county superintendent of schools, wrote:

> "The work was carefully and painstakingly done. At each step explanations clear and plain, in language easily understood by the plainest and most unlearned citizen, were made. In my work as superintendent of schools I have been in all parts of the county since, and everywhere people inquired about the work. The money spent by the state in these demonstrations is well worth while,—is indeed bread cast upon the waters that will return a hundred-fold enlarged."

At the demonstrations at Shelby there was a man in attendance who *walked* twenty miles for that one purpose, and at several meetings there were persons who had driven an equal or greater distance. And never before have we had such a deluge of inquiries from persons who want to begin spraying as we have had this spring.

The reader may think that we are overdoing the matter, that we are lessening the dignity of the profession by a cheap appeal to the public, but we have had that point constantly in view all the time and plead "not guilty." We have at times been accused of being too mild in our claims for spraying, and have been told that we should make our statements more positive and less conditional. Every detail of the work is thought out and provided for in advance, and we keep on the safe side of conservatism in our statements to the growers,—that is why we are getting their confidence in this matter, *because what we advise we have proven to them*. This is not cheapening our work, it is making it *available* and is making it *truly* economic.

We see no reason why similar demonstrations cannot be conducted in other lines of economic entomology. We note with interest that Mr. E. P. Taylor is doing something similar in Missouri in spraying for San José scale. The Geneva (N. Y.) Station has long conducted tests in potato spraying, which only lack the feature of publicity and audiences to make them true demonstrations. In Maryland Mr. Symons sprayed many orchards for the growers at cost prices. A very similar work is being carried on in Pennsylvania by Professor Sur-

face. The object-lesson method is the favorite one among entomologists in the class-room. Why not in the field application of our work?

This demonstration work is *not experimental work*. We use only the methods that are well established and proven beyond controversy; it involves nothing new, doubtful or investigational. We studiously avoid, for the sake of simplicity, the finer points of detail of which even entomologists are yet uncertain. Nor is it the same as the practical field test, since in field test work there is no invitation to the public to attend, watch and question.

No doubt there are states where such work as this would appeal to a smaller class than it does here. But we doubt whether there is a single state in which the *majority* of the orchards which are set for market purposes are sprayed systematically. We grant that the majority of the commercial growers may spray, because they have learned how, but there are hundreds who set out market orchards and whose orchards fail and remain utterly neglected because the benefits of spraying are never brought home to them in sufficiently forcible manner to be convincing.

NOTES ON MITES AFFECTING CHICKENS

By Glenn W. Herrick

The young chickens in the poultry yards at Agricultural College, Mississippi, have been curiously affected for the past two summers with a species of mite, or what is known in common parlance as "red-bugs."

On May 28, 1908, we examined two young chickens that were evidently diseased and found the sides of the body, beneath the wings where the feathers were scarce, bearing, here and there, rather large red nodules or tubercles, usually capped around the edges of the top at least with a hard scab or crust. In the center of the crust of each tubercle we found the red distended abdomens of numerous mites, with their heads buried in the tissues. When the scab was removed the mites came with it and left a comparatively large cavity in the center of the tubercle.

The mites were evidently gregarious and their presence in such numbers had stimulated the tissues until the nodule had been formed. Within the nodules were masses of whitish, fat-like tissue, composed of long, tapering cells. The mites were almost buried in these masses. Occasionally we found one isolated mite, especially between the secondary quill feathers of the wings. In each case its head was buried in the flesh like a tick.

On June 17 we examined other chicks from the same brood, which were now, of course, somewhat larger.

On chick No. 1 we found nodules now healing from which the mites had evidently escaped. We also found fresh tubercles on the sides of the body with mites in them. also isolated mites on the under sides of the wings.

On chick No. 2, on the right side of the abdomen, I found two very large tubercles. On one of them I counted the red abdomens of seventeen mites closely packed together like red berries, with their heads buried in the tissues of the tubercle like ticks.

On chick No. 3 I found a very large tubercle, showing the bodies of nine mites, and on chick No. 4 a tubercle was found with the bodies of nineteen mites clustered at the apex. All of these chickens were affected with other smaller clusters of mites, and with a few isolated ones on the under sides of the wings.

I submitted specimens of these mites to Mr. Banks for identification, and he wrote that they were "Leptus, that is, the larvæ of Trombidium. No species have as yet been bred in this country, so it is impossible to tell to what species your material belongs."

Professor Kerr, in observing the effect of these mites on the young chickens, says they soon succumb to the mite attacks. The chick seems to contract a diarrhœa, grows weaker and weaker, and finally dies. He thinks these mites are responsible for a high mortality among chickens in the South.

It is quite probable that these mites breed among weeds and tall grass, where the sun's rays cannot penetrate and where moisture conditions are favorable. It seems to me that young chicks liable to attacks from these mites should be confined to areas kept clear from weeds and tall grass. The mites will not be apt to breed in closely cropped grass and in an absence of shade. The heat of the sun would probably prevent their development.

INSECTS AND LEGISLATION

By E. P. Felt, *Albany, N. Y.*

It is interesting to note the effect of insect depredations upon legislation by our state and federal governments. The early laws provided simply for the study of injurious insects and plant diseases and for the dissemination of information concerning them through the press by means of reports and bulletins. Dr. T. W. Harris of Massachusetts was the first American entomologist to receive compensation from

the state for his reports, though there was no official entomologist in that state till 1870. New York led in 1854 by the appointment of Dr. Asa Fitch as entomologist to the State Agricultural Society, followed closely by the federal government the same year and by the states of Illinois and Missouri, making provisions for the work of official entomologists in their legislative sessions in 1866–1867 and 1867–1868, respectively.

These earlier workers, though poorly compensated and hampered by numerous and unnecessary restrictions, paved the way for the more comprehensive legislation of later years. California was a leader in enacting a general horticultural law, designed expressly for the control of the codling moth and other dangerous fruit pests. In 1895 there were only four states—and they western—which had general horticultural laws, while four others, Missouri, Kansas, Minnesota and Nebraska, had enacted special legislation, prompted by the extensive ravages by grasshoppers. But two states, namely, New York and Utah, had at that time made any legal provisions for the control of foul brood.

The discovery of San José scale in the eastern United States in 1893 and the subsequent alarm among horticulturists resulted in the enactment of numerous state laws, designed expressly to regulate the traffic in nursery stock and thus prevent the free dissemination of this pest. This is well illustrated by the fact that in 1898 fifteen states had enacted general horticultural laws, designed expressly to control injurious insects and for the most part directed against San José scale. Subsequent years witnessed great activities among legislators with horticultural interests, and in 1908 there were some thirty-nine states and territories which had in some way or other made legal provisions for the control of traffic in nursery stock.

Meanwhile the gipsy moth and the brown-tail moth had become well established in Massachusetts and adjacent states, and, as a result, all of the New England states and New York have made more or less comprehensive provisions for the control of one or both of these pests. Similarly the discovery of the boll weevil in Texas, and the danger of its spread to adjacent cotton-growing states, has resulted in legislation by Louisiana, Alabama, Georgia, Mississippi and South Carolina.

It requires no great mental acumen in tracing the above history to discover a distinct relation between cause and effect. Most, if not all, of the horticultural laws now current in the United States are the result of an insistent demand by a more or less extensive constituency. The first enactments were designed to meet the necessities of a serious

situation. The laws specifically provided for the control of certain injurious forms, and in some instances at least prescribed the methods of control. The experience of recent years has demonstrated the wisdom of more general acts, placing large discretionary powers in the hands of an executive officer. Furthermore, legislation originally designed solely for the control of either insect pests or fungous diseases has been broadened and amplified so as to include both. A few states have placed the control of insect pests and fungous diseases in the hands of separate officials.

The exact method of administration is not so important, provided there be a substantial harmony between the requirements of the individual states. No argument is necessary to demonstrate the wisdom of this, since it means a great saving of time and expense to shippers and dealers in all stock subject to examination and eventually a corresponding economy to the purchaser. Earlier legislation has been marked by greater or less divergence, while subsequent amendments have gone far toward producing a reasonable degree of harmony. The advantage of general provisions with large discretionary powers for the executive officer lies in the fact that the latter can readily modify requirements to meet the necessities of ever-changing conditions. An insect which may be rightfully regarded as a serious menace today may, a few months or years later, be ranked as of comparatively little importance so far as its shipment into a certain state or section of a state on nursery stock is concerned, owing to the fact that the territory under consideration may be generally infested and the introduction of a few more individuals be of comparatively slight moment. The earlier tendency of the western states was to establish the county system of inspection, doubtless due to the fact that certain counties possessed much more important horticultural interests than others. The tendency of some of these states at least has of late years been to strengthen the hands of the state authorities and make the county officials complementary thereto. The county system has not prevailed in the East, the universal tendency being to put the work in the hands of a state official.

The special conditions caused by the presence of the gipsy and brown-tail moths in New England has resulted in diverse legislation. The earlier efforts aimed at extermination. The later work has for its object control, and is based upon a somewhat elaborate plan of coöperation between state, municipal, village and town authorities. The state supervises the work and, if its requirements are met, partially reimburses the community, the refund being to a certain extent inversely proportional to the amount of taxable property. The federal

government, justly recognizing the danger of these insects spreading to other states, is assisting by giving particular attention to the prevention of the further spread of the insects. In addition, both the commonwealth of Massachusetts and the federal government are cooperating in a comprehensive scheme for the introduction and study of natural enemies of these pests in the hopes of securing some efficient natural check upon the hordes of devastating caterpillars.

The presence of the boll weevil in the cotton-growing fields of the South has wonderfully stimulated popular interest in entomological investigations and has resulted in the establishment of excellent quarantine regulations against this insect. A secondary development has been the greatly increased interest in the general work of the economic entomologist and more adequate provision for local investigations of that character.

Another incidental outcome of insect legislation is the enactment of laws regulating the purity of insecticides. This is but the logical sequence to the fertilizer laws now in force in many states and the pure food law of the general government.

The recent introduction of brown-tail moth caterpillars on nursery shipments from abroad has emphasized most strongly the necessity of quarantine regulations upon the Atlantic coast. This occurrence is but one of a series which amply justifies this nation in protecting itself from dangerous insects as well as destructive fungi. It is only a question of time before some such legislation will be enacted. Those responsible for the bill will undoubtedly draft a comprehensive measure which will afford ample protection without inflicting unnecessary restrictions. State legislatures are exhibiting greater friendliness toward comprehensive measures since they have become acquainted with the beneficial results which may follow, and it is to be expected that marked progress toward efficiency and moderate uniformity in requirement will accompany all subsequent amendments.

SOME NEW RECORDS OF APHIDIDAE IN NORTH AMERICA

By H. F. Wilson, *Agent and Expert*

INTRODUCTION

In the following pages the writer desires to redescribe a little known aphid which is remarkably divergent from other forms of the family Aphididæ and also to give data regarding two species known for many years to occur in Europe but which have not been recorded hereto from North America.

A NEW APHIS ENEMY OF BANANAS

Pentalonia nigronervosa Coquerel[1]

A species of Aphidæ has been found very abundantly on banana plants in the greenhouses of the United States Department of Agriculture and was without doubt imported on banana plants from some country where this fruit is grown.

Pentalonia nigronervosa Coq.

Winged viviparous female (Fig. 1).—General color reddish brown, eyes dark red, legs as long or longer than the body, antennæ reaching beyond the body and honey tubes; antennæ, nectaries and distal ends of the femora and tibiæ dusky red; remaining parts of the legs opaque, with a slight reddish tinge.

Antennæ situated on prominent tubercles, which are strongly gibbous on the inner side: segments 1 and 6 equal in length. 3 equal in length to 4 and 5 together, and both with ten or twelve round sensoria placed in a somewhat irregular line along the inner side of the segment: 4 somewhat longer than 5 and with six small sensoria, three of them near the middle and three toward the distal end: 7 long and slender, with two bristlelike hairs at the base; wings hyaline; veins distinct and bordered by dusky bands.

Venation of the wings varying considerably in individuals and often in opposite wings of the same specimen; first and second oblique veins nearly parallel, running transversely across the wing; cubital vein two-forked and distorted at or near the second fork, where the stigmal vein joins it, the two forming a single vein for a short distance, then separating and forming a distinct stigmal and a cubital vein. The fusing of these two veins also forms a closed cubital cell, which may or may not be called a true wing cell.

Nectaries about as long as third antennal segment and reaching slightly be-

[1]Am. Soc. Ent., France, p. 279 (1859). Fig.

yond the cauda; on live specimens semi-erect and pointing inward; general form cylidrical, slightly constricted in middle and at a point just beyond the flangelike end; cauda very short and ending in a globular tip.

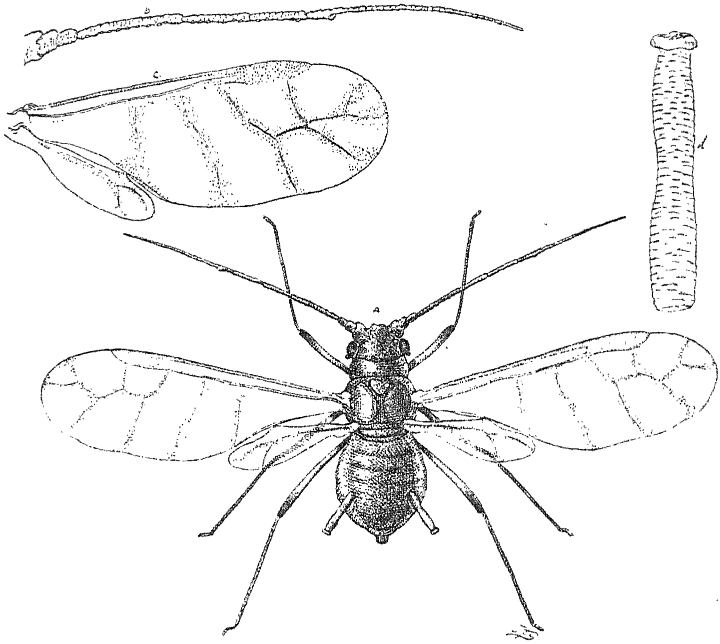


Fig. 7.—*Pentalonia nigronervosa; a*, winged viviparous female; *b*, antenna; *c*, wings; *d*, cornicles—*a* enlarged, *b*, *c* and *d* greatly enlarged (original).

Measurements: Length of body, 1.5 mm; width, .75 mm; length of antennal segments (1) .08 mm, (2) .08 mm, (3) .46 mm, (4) .30 mm, (5) .20 mm, (6) .09 mm, (7) .90 mm; total length, 2 mm; length of femora on hind leg, .75 mm; tibia and tarsi, 1.25 mm; nectaries, .3 mm; cauda, .07 mm.

Wingless viviparous female (Fig. 8).—General color light reddish brown; tip of antennæ and distal ends of femora, tibiæ and nectaries dusky; remaining parts of antennæ and legs opaque, with a reddish tinge.

Antennæ long, reaching back over the body past the ends of the nectaries; segments 2 and 6 equal in length, 7 as long as 3 and 4 together; antennal tubercles prominent and gibbous on the inner side; inner side of tubercles and front of head forming three sides of a rectangle; head with a slight elevation in front, on each side of which arises a short bristle. Nectaries slightly thicker than those of the winged forms but of the same length; cauda short, ending in a globular tip.

Measurements: Length of body, 1.20 mm; width, .75 mm; length of antennal segments (1) .09 mm, (2) .06 mm, (3) .35 mm, (4) .20 mm, (5) .18 mm, (6) .07 mm (7) .60 mm; total length, 1.55 mm; nectaries, .30 mm; cauda, .06 mm.

Winged male (?).—The male as described is questionable. Many small-bodied individuals were found on the plants with the winged and wingless females. On account of the size of the abdominal cavities, which would not seem to permit the development of young, the small individuals were taken to be males.

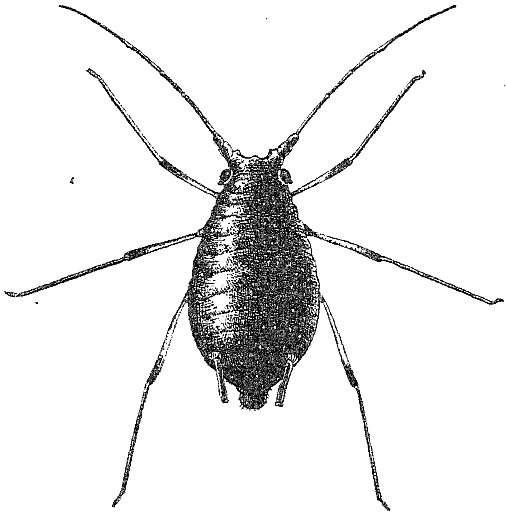


Fig. 8.—*Pentalonia nigronervosa*, wingless viviparous female, enlarged (original).

General coloration of parts same as in winged female, but antennæ without dusky tips. Antennal segments 2, 3 and 4 together as long as 7, which is long and slender, with a single short bristle at the tip.

The average measurements of five specimens are as follows: Length of body, 1.09 mm; width, .45 mm; length of antennal segments, (1) .07 mm, (2) .06 mm, (3) .36 mm, (4) .23 mm, (5) .20 mm, (6) .07 mm, (7) .64 mm; total length, 1.63 mm; length of wing, 1.8 mm; width of wing .70 mm.

Pupa. Similar to the wingless female and with gray wing-pads.

An ant, *Prenolepis parvula* Mayr, a common species about the department greenhouses, is an attendant on this aphis.

AN APHIS OCCURRING ON ANGELICA AND IVY

Aphis angelicæ Koch

Specimens of *Aphis angelicæ* Koch have been received by the Bureau of Entomology on numerous occasions for determination, but there is as yet no published record of its occurrence in the United States. Koch gives as its food plant in Europe *Angelica sylvestris*. In California it is recorded from *Angelica* sp. and ivy.

Winged viviparous female (Fig. 3).—General color grayish green, the gray being due to a pruinose secretion on the body; wings hyaline, veins clear; first 5 segments of antennæ, tip of beak, distal ends of femora and tibiæ and nectaries dusky yellow; eyes and thorax dark brown; last two segments of antennæ and the abdomen green. The abdomen of some specimens has 4 transverse, dusky dorsal bands, the edge of the fourth band coinciding with the base of the nectaries. These bands do not extend entirely across. They often merge to form an oblong black patch. An orange-colored band crosses the abdomen between the nectaries and seems to be fairly constant in all specimens.

Eyes semi-prominent; beak reaching beyond the second pair of coxæ; nectaries short and cylindrical; cauda obtuse, set with a few short hairs; antennæ shorter than body and very much roughened along segments 3, 4 and 5 by numerous irregular sensoria; segment 3 with thirty to forty prominent sensoria, 4 with ten to fourteen, and 5 with one large sensorium always present and occasionally also one very small one; segments 1 and 2 equal in length; segment 3 longest, slightly longer than 6 and 7 together.

Measurements: Length of body, 2.30 mm; width, .95 mm. length of wing, 3.15 mm; total expanse, 6.9 mm; length of antennal segments, (1) .07 mm, (2) .07 mm, (3) .40 mm, (4) .23 mm, (5) .15 mm, (6) .11 mm, (7) .26 mm; total length, 1.35 mm; length of nectaries, .16 mm; cauda, .13 mm; width of cauda at base, .10 mm.

Wingless viviparous female.—General color green, covered with a fine gray pruinosity which gives them a dark appearance; eyes dark red; femora, tibiæ, antennæ, nectaries and cauda dusky; remainder of body green; abdomen with a deep orange spot at the base of each nectary, and two or three transverse dusky bands crossing just behind the nectaries; antennæ and head with a few short hairs; cauda obtuse; antennæ less than half as long as the body, segment 2 being the shortest and 7 the longest; nectaries cylindrical and shorter than in winged specimens.

Measurements: Length of body, 2.6 mm; width, 1.2 mm; length of antennal segments, (1) .09 mm, (2) .06 mm, (3) .23 mm, (4) .13 mm, (5) .1 mm, (6) .09 mm, (7) .27 mm; total length, .95 mm; length of nectaries, .24 mm; cauda, .7 mm; width of cauda, .08 mm.

Pupa.—General color green; antennæ and tibiæ dusky at distal ends; eyes black; in other respects similar to wingless females; length of body, 2mm; length of antennæ, .9mm.

AN APHIS ON MAPLE IN CALIFORNIA

Drepanosiphum platanoides Schrank

Specimens of a large and beautiful aphis (*Drepanosiphum platanoides* Schrank) were sent to this bureau during the year 1908 by several correspondents on the Pacific coast. This species does not seem to have been noticed previously in North America by anyone interested in the study of aphides, and since all the specimens at hand came from California perhaps it does not occur in the more eastern states.

In the year 1848 Francis Walker[1] gave an account of the life his-

[1] Ann. and Mag. Nat. Hist. (2), vol. 1, p. 250–254.

tory in England and mentioned ten varieties of the species, suggesting that there is evidently quite a variation in color and size.

A very interesting difference of form is noticeable in the viviparous and oviparous females, in the shape of the body, the former being stout and short and the latter long and spindleshaped. Prof. C. P. Gillette, in describing a new species of this genus, *Drepanosiphum braggii*, figures the egg-laying female of that species, which shows the elongate spindleshaped abdomen, and explains the method of egg deposition.

Descriptions of the forms at hand taken on maple (*Acer* sp.) at Lorenzo, Cal., by Mr. I. J. Condit are given below:

Winged viviparous female.—General color reddish yellow; head at base, dorsal plates of thorax, joints of legs and tarsi dark; femora and tibiæ dusky orange; antennæ dusky at base, paler at tip; nectaries yellow, with dark tips; cauda reddish yellow; wings hyaline, long, and held in horizontal position when at rest; stigma opaque; veins dusky, ending in indistinct dusky margins.

Antennæ long and slender, almost twice as long as the body, and set on large prominent tubercles: segment 3 as long as 6 and 7 together, and with fifteen to twenty or more elliptical sensoria placed in a regular line along the upper outer edge of the basal half of the segment; segment 5 with one large sensorium near the distal end: 6 with three to five large sensoria irregularly placed on the segment and distinctly separated from each other; all the segments set with short, spinelike brisles; tip of segment 7 with two setaceous hairs; head broad, with two long and two short hairs in front; the two ocelli adjoining the eyes quite prominent and having a dusky ring around the base of each.

Prothorax long, with several tuberculate hairs on each side; abdomen robust, set with numerous short hairs arising from prominent tubercles. Legs set with numerous short hairs; tibiæ long and slender, femora short and stout.

Nectaries slightly curved outwardly and swollen in the middle. Cauda short and conical.

Measurements: Length of body, 2.72 ^{mm}; width, 1.04 ^{mm}; length of antennal segments, (1) .20 ^{mm}, (2) .08 ^{mm} (3) 1.6 ^{mm}, (4) 1.2 ^{mm}, (5) .84 ^{mm}, (6) .15 ^{mm}, (7) 1.4 ^{mm}; total length, 5.47 ^{mm}; length of wings, 4.8 ^{mm}; total expanse, 10.32 ^{mm}; length of nectaries, .96 ^{mm}; cauda, .2 ^{mm}.

Winged oviparous female.—General color reddish yellow to yellow; head, antennæ from middle of segment 3 to end of 6, distal ends of femora and tarsi dusky; ends of nectaries dusky orange; dorsal and ventral plates of thorax dark brown. The general characters are similar to those of the viviparous female, with the exception of the abdomen, which is longer and is spindleshaped. This form probably does not occur until fall, but as late as November the viviparous forms can be found on the underside of the leaves. Length of body, 3mm; other measurements as in winged, viviparous female.

Pupa.—The pupæ of both forms are similar to each other, except as to the shape of the abdomen, which in the one case is robust and in the other spindleshaped. Color light reddish throughout.

PLANT LOUSE NOTES, FAMILY APHIDIDAE; PLATE 12

By C. P. Gillette

On June 21, 1909, the writer left Fort Collins for a trip east, and made short stops at Chicago, Illinois; Lansing, Portland and Detroit, Michigan; Rochester, Geneva, Albany and New York City, New York; Palisades, near Fort Lee, New Jersey; and Washington and Georgetown, D. C., for the purpose of collecting and taking notes upon species of Aphididæ and seeing as many types as possible. In the same month Mr. L. C. Bragg started upon a vacation trip east, during which he made collections and notes on Aphididæ at Lawrence, Kansas; Kansas City, Missouri; Union City, Indiana; Springfield, Amherst and Wood's Hole, Massachusetts; and then, between August 18th and 27th last, the writer collected aphids at Portland, Hood River, Oregon City, Dundee, Corvallis and Salem, Oregon; and Seattle, Washington. The notes cover more than one hundred species and the object of this paper is to bring the more important of these notes together, with brief comments upon the occurrence of the same species so far as we have taken them in Colorado.

To avoid repetition, I will give here, once for all, the dates at which captures were made at the different points visited.

The dates of Mr. Bragg's collections were: Lawrence, June 5 to 10; Kansas City, June 11 and 12; Union City, Ind., June 13; Springfield, June 14 to 16; Amherst, June 16; Webster, June 17 to 28; Wood's Hole, June 28 to July 5.

My dates were: Chicago, June 23; Lansing, June 24; Portland, Mich., June 25 and 26; Detroit, June 27 and 28; Rochester, June 29; Geneva, June 29 and 30; Albany, July 1; Central Park, N. Y., July 2; Palisades, near Fort Lee, July 2; Washington and Georgetown, July 3, 4 and 5; Portland, Ore., August 18 to 20; Hood River, August 21; Oregon City, August 22; Dundee, August 23; Corvallis, August 23 and 24; Salem, August 24; Seattle, August 27.

I was specially helped in this work by Mr. J. J. Davis in Chicago, Dr. E. P. Felt at Albany, Doctor Beutenmuller at Palisades and Mr. H. Wilson at Washington and Georgetown.

FITCH'S TYPES

While at Albany Doctor Felt kindly unsealed the case of Fitch's types for my inspection. I had wondered how it happened that Fitch always had males of his plant lice to describe. An examination of his types indicates that, to Fitch, all winged lice were males, as will appear from the following notes:

Notes on Types Examined

"*Aphis mali,* male, No. 839." In very poor condition but one hind wing is still present, showing the specimen to be a viviparous female.

"*Aphis cerasi,* male, No. 840." In too poor condition for determination.

"*Aphis berberis,* No. 842, male; 840, female." In too poor condition for determination.

"*Aphis brassicæ,* male, No. 844." In very bad condition but with wings present.

"*Aphis rudbeckiæ* (*Macrosiphum*), male, No. 853." An alate louse in fair condition.

"*Aphis lanigera* (*Schizoneura*), male, No. 861." A winged louse, evidently the viviparous pre-sexual form.

"*Aphis pyri* (*Schizoneura*) male, No. 862." Winged viviparous female, like preceding.

"*Aphis imbricator,* male and female." The wing of the supposed male has true *Pemphigus* venation.

The specimens are all mounted on cardboard points on pins.

FIELD NOTES

Chermesinae

Phylloxera c-venæ Fitch. Abundant on hickory leaves at Rochester and Georgetown. Galls along midrib or main veins and usually near the margin of a leaf. Within were eggs, larvæ and pupæ; none alate at Rochester. Syrphus larvæ were also common in the galls. Stem females, eggs and alate adults were in the galls at Georgetown. The eggs and stem females are very pale yellow, almost white; pupæ dusky yellow.

Phylloxera c-fallax Walsh. Noticed at Rochester only on hickory leaves. Many of the lice were alate; galls abundant.

Phylloxera intermedia Perg. Taken on hickory leaves at Rochester and Geneva, N. Y., and Georgetown, D. C. At Rochester stem-mothers, eggs, larvæ, pupæ and alate adults were abundant.

Phylloxera vastatrix Planchon. Galls on leaves of wild grape vines, common at Portland, Mich., Geneva and Georgetown.

Chermes abietis L. Abundant on Abies nigra in City Park, Albany, July 29. None of the lice ready to leave the galls, though many are pupæ. The very pale yellow, almost white, color of larvæ and the position of the galls, not terminal, are conditions quite in contrast with the rusty brown lice and the terminal position of the galls in case of *Chermes cooleyi.* Galls also taken at Geneva.

I have seen a few small galls of this species in City Park, Denver, upon spruces brought from the East.

Chermes laricifoliæ Fitch. Rather abundant on *Larix americana* on campus of Michigan Agricultural College and at Geneva.

Chermes pinicorticis Fitch. On *Pinus strobus* at Lansing and at Albany. It is commonly very abundant in City Park, Denver, upon the same pine.

Pemphiginae

Tetraneura ulmicola Fitch. At Lawrence, just beginning to get wings; at Geneva galls very common, some turning red and in these were many alate lice and pupæ. In the green galls all were nymphs. Many galls of this species were also seen at Washington. Have once seen galls of this species in Fort Collins upon an elm from an Iowa nursery, set the foregoing spring. Figs. 1, 2.

Hamamelistes spinosus Shimer. The powdery apterous form of this louse was taken in abundance upon the under side of the leaves of white birch at Albany. At Washington the spiny galls were taken from witch hazel (*Hamamelis virginica*) along with the galls of *Hormaphis hamamelidis*. The galls were reddish, and were packed with lice of about the same color. In each was found a very robust, almost globular, stem-mother and lice of all stages, including the winged form.

Since my return Mr. O. G. Babcock, a special student in entomology, on August 2 brought me from the foothills near Fort Collins, at an altitude of 7,000 feet, several leaves of the mountain birch (*Betula fontinalis*) upon which were colonies of Hamamelistes that seem in every way to agree with the characters of *spinosus*. This seems strange as the witch hazel family is not known to occur in the Colorado fauna for the alternate form of this species, which would seem to be necessary according to the careful work done by Mr. Pergande upon this louse in the East. It is possible that the Colorado form may be a distinct species with a different alternate food plant not yet discovered. Upon the other hand it is possible that this louse is able to continue from year to year upon the birch. We have found that many lice which have the habit of alternating their host plants are able to continue indefinitely upon one of them. Migration to a new food plant in early summer seems to be for the purpose of getting away from natural enemies that have rapidly increased upon the winter host, and this habit is probably a comparatively recent development. So it is not strange that in many species we find this migrating tendency failing to be universal among the individuals of a colony. *Chermes cooleyi*, during early July, almost completely leaves the blue

spruce to go to the red spruce, but only about 50 per cent. of the form (*var coweni.*) on red spruce migrate to the blue spruce each June.

Phorodon humuli and *Hyalopterus arundinis* winter upon the plum and leave in early summer for herbaceous plants, but we have found occasional colonies of both these species continuing throughout the summer on plum foliage; *P. humuli* is known also to spend the entire year upon the hop. *Aphis bakeri* uses the apple and the thorn (*Crategus*) as its winter hosts and the clovers for its summer food plants, but we find it remains commonly upon red and white clovers throughout the year in protected places, and occasional late summer colonies have been found upon apple sprouts. Other similar cases might be added to the list. Fig. 3.

Hormaphis hamamelidis Fitch. The smooth cone-shaped galls of this species were taken in great numbers upon leaves of witch hazel at Washington, Webster, and Wood's Hole. The galls contained one stem-mother and in each case examined many of her offspring in all stages of growth including adult winged examples. In color these lice resemble those in the spiny galls of the preceding species. Fig. 4, 5.

Pemphigus betae Doane. Taken at Salem, Oregon, where it was common upon roots of *Chenopodium album* in an apple orchard. Apterous form and pupæ were seen, but none that were alate.

This is a serious sugar beet pest in Colorado occurring upon the eastern and western slopes. So far as I can learn this species does not occur much east of the eastern line of Colorado. We find the native asters and golden rods (*Aster* and *Solidago* sp.) favorite host plants, while it is also common on the roots of *Chenopodium* and *Iva*. Sensoria on antennal joints about as follows: three, 6 to 7; four, 2; five and six, 1 each. See fig. 6.

Pemphigus fraxinifolii Riley. This louse is very common upon white ash in Colorado, but we did not meet with it anywhere east of Colorado. I found the louse and its injuries very common upon the native ash (*Fraxinus oregona*) about Portland, Oregon. It seemed specially abundant upon little trees that were but a few feet high, tightly curling the leaves, many of which were dead. Sensoria: joints three, 5 to 7; four, 4 to 5; five, 5 to 6; six, 2 to 3. Fig. 7.

Pemphigus acerifolii Riley. Mr. Harley Wilson showed me this species at Georgetown on silver maple (*A. dasycarpum*). The lice had nearly all left the folded leaves which they had inhabited, and the leaves had ripened and fallen. Some large trees had been badly infested. This is a very large species, measuring as much as 4.50^{mm} in body length and spanning fully 10^{mm} from tip to tip of wings. The antenna is very short, barely exceeding 1^{mm}, and the sensoria are con-

fined to the under surface of the segments, there being only slight indications of the sensoria from above. The numbers of sensoria per segment are about as follows: Joints three, 11 to 13; four, five and six, 5 to 6 each. Fig. 8.

Pemphigus corrugatans Sirr. This species seems common and widespread, curling the leaves of *Crategus* and *Amelanchier*. It was abundant in curled leaves of *Crategus macrocapetra* and *C. crusgalli* at Lansing, and leaves of *Amelanchier canadensis* at Kansas City, Springfield, and Webster. Alate lice was found in all cases. This is a common species upon *Amelanchier alnifolia* and *Crategus occidentalis* in the foothills near Fort Collins and upon what I take to be the same plants at Paonia, Colorado. Sensoria: Joints three, 16 to 20, four, 4 to 6,; five 2 to 3; six, 1. Fig 9.

Pemphigus ulmifusus Walsh. The galls of this species were shown to me by Dr. Beutenmuller of Palisades, N. J. The leaves of a small elm were much infested, the larger galls being fully two inches in length. Just an occasional gall was beginning to turn yellow, and in these some alate examples were found. In all the galls stem-mothers were still present; they were very pale yellow in color, large and sub-globular. All of the descendants from the stem-mother were acquiring wings. This gall was abundant on small elms at Washington, but the inmates had escaped. At Woods Hole alate lice were abundant in the galls.

The alate lice I took were larger than those Thomas described (Eighth Ill. Rep. p. 153), averaging 1.60^{mm} in body length and fully 2.20^{mm} to the wing tips, and I find no well marked indication of a fork to the cubital vein. The antenna has joints 3, 4, 5 and 6, all heavily ringed, joint 4 being usually the shortest and 5 and 6 subequal. The most pronounced peculiarity of the antenna is the absence of a distinct unguis as a differentiated portion of joint 6, resembling in this respect, *Hamamelistes*. Fig. 10.

Pemphigus tessellata Fitch. This species was taken by Mr. Bragg from the underside of limbs of alder at Webster and Woods Hole. Apterous examples only were seen.

Pemphigus populitransversus Riley. Taken on cottonwood leaves at Rochester and at Webster. Very few galls seen. This is a common species infesting cottonwoods in Colorado. Sensoria: Joints three, 3 to 5; four, 0–1; five and six, 1. Sensoria in distal portion of joints 5 and 6 very large, with 2 to 4 minute hairs in each. Fig. 11.

Pemphigus populiconduplifolius Cowen. Stem-mothers and young of what seem to be this species were taken in folded leaves of *populus*

balsamifera at Lynn, Mass., June 27. Sensoria: Joints three, 20 to 25; four, 6 to 8; five, 6 to 7; six, 5 to 7. Fig. 12. Drawing from Colorado specimens.

This louse is of occasional occurrence in Colorado upon the broad leaved cottonwoods. The upper surface of the leaf folds together along the line of the midrib and the sides puff out like a well filled purse.

Pemphigus populimonilis Riley. Not noticed east, but was very common upon terminal leaves of *Populus trichocarpa* about Portland, Oregon. Many of the little pockets were dissected and in some syrphus larvae were seen, but in others were the living lice, one in a gall. All acquire wings. Apparently the young migrate from the gall almost as soon as born and start a home of their own by the irritation that their beaks produce in the growing leaf. This species is extremely abundant upon young narrow-leaved cottonwoods (*P. angustifolii*) in Colorado. Sensoria: Joints three, 6 to 9; four, 3 to 5; five, 1 to 3; six, 1. Fig. 13. From Colorado specimens.

Pemphigus vagabundus Walsh. A single gall, quite immature, was taken from cottonwood at Rochester.

This species is comparatively rare in Colorado, but occasionally a small tree is quite badly infested. The antenna has a very long unguis for this genus and what is more remarkable the unguis seems to have three sensoria. See Fig. 12. Sensoria as follows: Joints three, 10; four, 2; five and six, 1 each; unguis 3. From alate lice taken at Chicago, Ill., by J. J. Davis, and at St. Louis, Mo., by J. T. Monell, Fig. 14.

Schizoneurinae

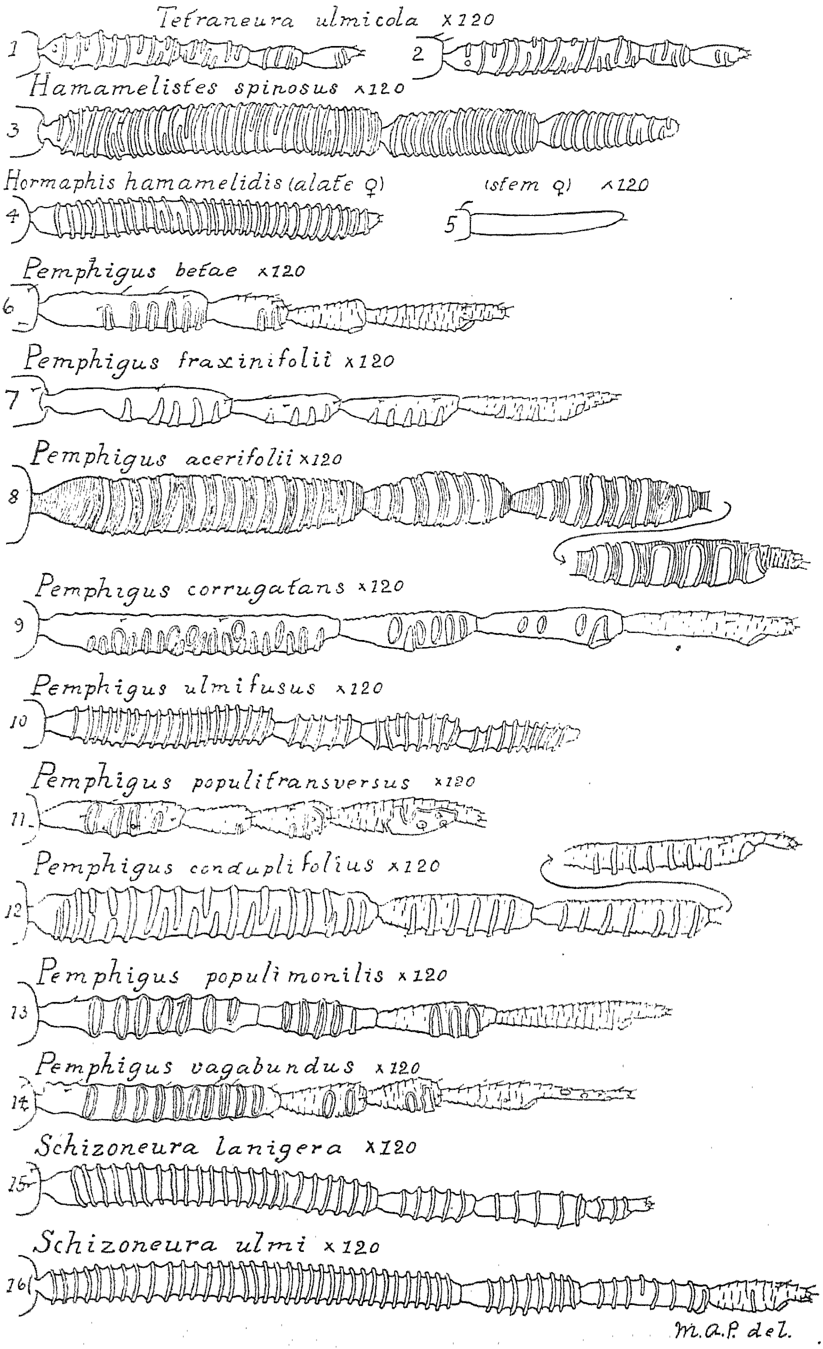
Schizoneura lanigera Hausm. This species, almost universally present in apple orchards, was not specially searched for but was noticed at Geneva, Central Park, Washington and Lawrence, and was nowhere very abundant. This is one of the most serious and generally distributed insect pests of apple orchards in Colorado. Mr. Bragg found the alate pre-sexual form at Lawrence. So far as I know this is the earliest date for the alate form. Mr. George P. Weldon reported an alate louse of this species at Austin, Colorado, July 15, 1909. Figure 15 shows an enlarged antenna.

Schizoneura ulmi L. (*americana* Riley). Many alate lice and nymphs in rolled leaves of American elm at Geneva, Albany, Lawrence and Wood's Hole. The curled leaves were also seen at Washington and Georgetown, and on European elm (*Ulmus campestris*) at Corvallis. This louse is a real pest upon white elm nearly everywhere that this tree is grown in Colorado. The antenna is shown in Fig. 16

Schizoneura rileyi Thos (*ulmi* Riley). This louse was described from the tender growing bark of the elm by Dr. Riley and was seen by Mr. Bragg at Wood's Hole; it is also of common occurrence at Fort Collins and other places in Colorado. I am unable to separate it with any certainty from *ulmi*, so incline to believe the two forms are one species.

Galls were taken at Corvallis on *Ulmus campestris*, or European cork elm, that were very large pocket-like swellings, often involving the entire leaf and with a large wide open mouth below. As the few alate lice taken seem not to be specifically distinct from the specimens we have taken from the common form of this gall on the American elm, I am not considering it a different species.

Plate 12. Antennæ of Aphididæ. All alate viviparous females, except Fig. 5. All enlarged 120 diameters. One and 2 are 6 and 5 jointed antennæ from the same individual of *Tetraneura ulmicola;* 3, *Hamamelistes spinosus;* 4, from alate form and 5 from apterous stem-mother of *Hormaphis hamamelidis;* 6, *Pemphigus betæ;* 7, *P. fraxinifolii;* 8, *P. acerifolii;* 9, *P. corrugatans;* 10, *P. ulmifusus;* 11, *P. p-transversus;* 12, *P. p-conduplifolius;* 13, *P. p-monilis;* 14, *P. vagabundus;* 15, *Schizoneura lanigera;* 16, *Schizoneura ulmi.* Original, Miriam A. Palmer, delineator.



ANTENNAE OF APHIDIDAE

CALIFORNIA HORTICULTURAL QUARANTINE

By C. W. Woodworth, *Berkeley, Cal.*

Entomologists are generally unacquainted with the actual facts relative to the working of the California horticultural laws. The supposition is that they have really prevented the introduction of insects. During the period of the greatest horticultural expansion California had absolutely no restrictions on importations. The quarantine laws have been effective now for more than a score of years. In 1896 Mr. Alexander Craw, then horticultural officer at the port of San Francisco, gave a list of "injurious insect pests found on trees and plants from foreign countries."[1] These were the insects which he considered liable to be introduced but which the quarantine was expected to prevent.

The publication of a "Host Index of California Coccidæ" by Essig and Baker[2] contains data for checking up the preceding list, largely supplied by Mr. Edward M. Ehrhorn, the successor of Mr. Craw. The following species are noted as established in California:

1. *Pseudaonidia duplex* Coc. (*Aspidiotus duplex*) in greenhouses (p. 56).
2. *Chrysomphalus aonidium* Linn (*Aspidiotus ficus*) in greenhouses (p. 55).
3. *Hemichionaspis aspidistræ* Sign. (*Chionaspis aspidistræ*) in greenhouses (p. 55).
4. *Chionaspis euonymi* Coms. in nursery houses (p. 60).
5. *Fiorinia fiorinæ* Coms. (*Fiorinia camelliæ*) in greenhouses (p. 56 and 58).
6. *Lepidosaphes beckii* Newm. (*Mytilaspis citricola*), recorded by Craw as already established in one locality in San Diego County and eradication urged, on orange (p. 57).
7. *Lepidosaphes gloveri* Pack (*Mytilaspis gloveri*), same record as above, on orange (p. 57).
8. *Parlatoria pergandei* Coms. on orange and camellia (p. 56 and 57).
9. *Pseudococcus aurilanatus* Mask (*Dactylopius aurilanatus*) in greenhouses (p. 59).
10. *Eucalymnatus perforatus* News. (*Lecanium perforatum*) in greenhouses (p. 56), on sweet bay tree (p. 62).
11. *Orthezia insignis* Doug. on Lantana (p. 61).

[1]Fifth Biennial Report of the State Board of Horticulture.

[2]Pomona Journal of Entomology, Vol. I.

This list constitutes nearly a third of those mentioned by Craw, and does not by any means include all the species that have become residents of the state during this interval. The horticultural officers were particularly on guard against these scales, but they nevertheless found admittance. These facts do not reflect upon the care of our horticultural officers because their work has always been most painstaking and earnest, but do seem to indicate the futility of such effort.

AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

The twenty-first annual meeting of the American Association of Economic Entomologists will be held in Boston, Mass., during the last week in December, 1909. A further notice will be sent to all members before the first of November, together with a blank to be filled out by all members desiring to present papers at the meeting. In order that the program can be made up so that it can appear in the next issue of the JOURNAL and in the general program of the American Association for the Advancement of Science, it is necessary that the blank be filled out promptly and returned to the secretary.

Application blanks for membership should be secured from the undersigned at once so that they can be filled out and returned in advance of the meeting. This will greatly facilitate the work of the Membership Committee.

The meeting at Boston promises to be one of the best held by the association and it is hoped that the entomologists from all sections of the country will make it a point to be present.

A. F. BURGESS, *Secretary*,
Bureau of Entomology, Washington, D. C.

Discussion and Correspondence

The JOURNAL has endeavored to maintain an independent attitude and at the same time accord fair and courteous treatment to all. It is impossible for the editor to personally verify all statements submitted in manuscript. He can only hope to exclude the more patent errors. Authors, including those submitting reviews, must be held responsible for their statements, provided the copy has been followed.

The following communication, dated at Cambridge, England, July 27, 1909, and addressed to the editor, requires no explanation:

"We notice in your issue of June, 1909 (Vol. II, p. 259), a review of our book, 'TICKS, A MONOGRAPH OF THE IXODOIDEA,' over the signature of N. Banks. We are the last to question the right of the reviewer to form and publish an unfavorable opinion of our work, and must bear with what philosophy we can the low estimate in which he holds it, but it is perhaps permissible to protest strongly against his distorted and misleading statement of facts. When the reviewer states that the work 'is not a monograph in any sense of the word,' we cannot but express our astonishment and would refer him to any English dictionary for a definition of the word monograph. Our copy of Webster defines a monograph as 'a written account or description of a single thing or class of things; a special treatise on a particular subject of limited range.' Perhaps Mr. Banks does not use a Webster's dictionary. When Mr. Banks states that we have not studied the collections belonging to Neumann nor those in Berlin and Paris he is making a statement about facts of which he has no personal knowledge, for we have received and studied specimens from all the three sources named. We have examined five out of the six valid species of *Argas,* and our descriptions are based upon our own examination of these species. Similarly, we have personally studied eight out of the eleven valid species of *Ornithodoros.* Consequently the reviewer's statement that a 'number of species known to Doctor Neumann are unknown to them . . . ' gives a false impression to anyone reading the review.

"In all cases we have given the fullest credit to other authors. The gratitude we receive at the hands of Mr. Banks is comprised in his statement that we give a 'brief technical description (in many cases more or less compiled).' Naturally compilation has been necessary, but to slur over the original matter in the book as does Mr. Banks is unjust. In compiling we have sifted little wheat from much chaff, and, wherever we have been able, we have added information acquired by ourselves. This work has entailed much labor, which we are confident

is appreciated in competent quarters. Our 'brief technical descriptions' to which Mr. Banks appears to object are intentionally brief. We do not believe in padding descriptions with useless detail, but seize upon the *essential* characters which, in our opinion, after a survey of the group, serve for the recognition of a species.

"With regard to the reviewer's concluding statement that 'most of the figures are taken from Neumann. The plates are original—,' we would say that there are 116 figures (not 114). Of the 116 figures 45 are original, 43 are reproduced, by kind permission, from Neumann's original blocks and 28 are from figures by other authors. Of the 9 figures on the 3 plates 6 figures are original and 3 are reproduced from other authors. Are we to accept this as an example of Mr. Banks' sense of fair play or of the scientific precision which characterizes his 'brief technical description' of our book?

"We fear that Mr. Banks has unfortunately transgressed the line of legitimate criticism . . . We regret that we have been unable to make anything of his descriptions of two species of *Argas*. That others have experienced a similar difficulty with his diagnoses appears from the fact that in 'Das Tierreich' (Lieferung 3, Acarina) while eight of his species of *Oribatidæ* are admitted as possibly valid, sixteen are relegated to the category of 'doubtful.'

"Yours truly,

"Geo. H. F. Nuttall, *Quick Professor of Biology in the University of Cambridge.*"

Scientific Notes

Injurious June Beetles, *Anomala marginata* Fabr.—At the office of the state entomologist at Blacksburg, Va., a complaint was recently received from Patrick County, Va., to the effect that a large apple orchard was being damaged seriously by some leaf-eating insect and request made for an investigation. A visit on July the 14th, 1909, revealed the fact that a large number of the apple trees in this orchard had been partially defoliated by a species of June beetle. The orchard consisted of about thirty thousand apple trees, from three to eight years old. The damage done to this orchard was so extensive that a portion of it presented a dull brown, unhealthy appearance from a distance. The trees most seriously damaged extended over an area of probably one hundred acres. Some trees were damaged more than others; some of the smaller ones had but few leaves left.

There were about twelve grape vines in front of the manager's dwelling, small vines of two or three years' growth, that were entirely defoliated.

There were several hundred of these beetles on one apple tree in some

cases. Upon being disturbed these insects fall to the ground as though dead, but become active on reaching the grass under the tree.

Their feeding habit closely resembles that of the Rose beetle, only they do not appear to attack the fruit save in rare instances. They seldom fly and when they do their flight is only for a few feet, from one limb of the tree to the other.

But comparatively few of these insects were left on the above date as the manager states that they appear about the middle of June and leave about the middle or latter part of July.

Specimens sent to Dr. L. O. Howard were identified by Mr. Schwarz as *Anomala marginata* Fabr. They are very like the common "June bug" found during the summer season on blackberry bushes, feeding on the fruit, only they are about half the size. The male of this species seems to have the peculiar habit of hanging on to the female, clasping the posterior portion of her abdomen with his anterior pair of legs when not feeding. The male is somewhat smaller than the female, abdomen darker, thoracic segment more narrow and deeper green.

The examination of this orchard was made after two o'clock in the afternoon. The manager states that these insects have been doing some little damage for the past two or three years but had been much worse during the present season than ever before. An examination of the surrounding orchards in this locality was not made at that time but no other similar complaints were received at this office.

J. C. Stiles, *Assistant Entomologist, Virginia Crop Pest Commission*

Insect Work on the Shade and Ornamental Trees in Brooklyn for 1909.— This year was the first one in the history of Brooklyn that the insect enemies of its shade and ornamental trees were controlled with a marked degree of success. This is due partly to the egg-destroying work of the previous years, partly to the additional equipment of gas spraying machines and the early spraying, but more than anything else to the better grades of spraying material employed. For many years past the spraying done in this city proved ineffective. The futile results were of common note, but the cause was unknown. Last year a few chemical tests with the arsenate of lead in use told the whole story. This year five other brands of lead, selected according to the tests recorded in Bulletin 214 of the N. J. Agric. Experiment Station, were employed and all proved efficient. Twenty-three thousand pounds of lead were used and over forty thousand trees were sprayed. The Tussock Moth, our worst enemy, and *Datana ministra* were the most numerous caterpillars. The elm-leaf beetle was very abundant, but was readily subdued by the early spraying and later by the oil emulsions applied at the base of the trees during the period of pupation. The scurfy and oyster shell scales were thickly infesting five thousand elms, and an application of whale oil soap at the rate of one pound to six gallons of water (suggested by Prof. John B. Smith) proved very effective. The Ailanthus and Cynthia moths and the bag-worm, though very numerous last season, were hardly seen this year. The few pupæ of these species all seemed to have been parasitized. The new pests which are becoming formidable are the linden borer (*Saperda vestita*) on the European lindens and the hickory bark borer (*Scolytus quadrispinosus*) on all species of hickories. The former is as yet not very serious and the injections of

carbon bisulphid together with the removal of the badly infested trees proved very serviceable, but the hickory bark borer is becoming the most dangerous enemy, threatening over a thousand trees in Prospect Park and sixteen thousand others in Forest Park. Every effort is being made to check its ravages.

J. J. LEVISON, *Arboriculturist.*

Control of the Codling Moth.—At the meeting of the American Pomological Society at St. Catharine's, Ontario, on September 15, Mr. L. CAESAR of the Ontario Agricultural College discussed studies made by him in the orchards of Jos. Tweedle at Stony Creek, Ontario, this year. He applied the first spray just as the blossoms dropped, June 4–7, but was delayed on the south half of the orchard until June 10–12 on account of high winds. At the latter date but few calyces had closed. Two pounds of arsenate of lead per barrel, a pressure of 140 pounds with a Friend pump and Friend nozzles at a 45 degrees angle were used. The spray was directed into the calyces and the trees were thoroughly drenched in an effort to lodge the spray in the lower calyx cavity. On the Spy, Jonathan and Van Deveer this was successful because the stamens stand wide apart, but on the Greening, Golden Russet, Red Astrachan and other varieties it was found impossible to penetrate the stamens with the spray. The second spraying was applied June 25 to July 2, when the eggs had been laid and some had been hatched. At this spraying self-boiled lime-sulfur mixtures, 8–8–50, with 2 pounds arsenate of lead, was sprayed with small aperture nozzles at 160 pounds pressure. On July 28 the trees were examined and on the north half, where sprayed June 4, 99% of the fruit was found uninfested, which was equally true of varieties in which the spray had not penetrated to the lower calyx cavity. Ninety-four per cent. was found clean on the southern half sprayed June 10. Many larvæ which had entered at the sides of the fruit were found to have died after entering. On September 13, when the second brood had entered the apples, the trees were again examined. On the north half 90% were perfect and there were no wormy calyces, while on the south half 75–80% were clean and there were some wormy calyces. Unsprayed orchards nearby had 50 to 100% wormy and the orchard sprayed had been 50% wormy the previous year. Two full broods occur in the Niagara peninsula.

E. D. SANDERSON.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

OCTOBER, 1909

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints of contributions may be obtained at cost. Minor line figures will be reproduced without charge, but the engraving of larger illustrations must be borne by contributors or the electrotypes supplied. The receipt of all papers will be acknowledged.—EDS.

Over a year ago the editor called attention to the advisability of publishing certain matter, particularly general notes, in the October and December issues, partly because it would limit the amount of material awaiting publication early the following year, and also on account of the gain to be derived in case discussion was desired. Our gatherings afford unique opportunities for the discussion of papers from a variety of standpoints. It would be most desirable if entomologists could acquire the habit of publishing, at least in abstract, certain types of papers which they wished to have discussed at a coming meeting. Announcements of investigations contemplated and methods to be pursued are especially appropriate, and we trust that something of the kind may be seen in the December issue. Such announcements and discussions, if they accomplished nothing else, would bring those following similar lines into closer touch and might result in extremely valuable coöperation.

An article on a preceding page discusses one method by which the economic entomologist may reach the public and opens a question of much importance to many readers. Some years ago Doctor Forbes placed himself on record as follows: "It is not the facts of entomology we discover, but those which we persuade the farmer, the gardener or the fruit grower to use diligently for the protection or the preservation of his crops which make our entomology economic." This statement is most emphatically true at the present time and the entomologist who does not present his results to his clientage in a convincing manner fails to perform a most important duty. The precise method must of necessity depend largely upon the character of the work performed and especially upon local peculiarities. Methods of great value in a community possessing small knowledge of general entomology may be entirely inapplicable to a group of well informed fruit growers or progressive men engaged in other lines of agriculture.

Demonstration work is particularly adapted to localities where there is very little interest in economic entomology. Practical experimental work in well-informed communities is most important, since such localities, whether special attention be given to publicity or not, in reality become university extension centers. This discussion might be greatly amplified and undoubtedly much of value would be derived therefrom if entomologists from different parts of the country would give us the benefit of their experience.

The advisability of making changes in the management of the JOURNAL is a matter likely to come up for consideration at the coming meeting. The JOURNAL PUBLISHING COMPANY was organized primarily to afford a ready means for the publication of the proceedings of the American Association of Economic Entomologists. There was no thought of monetary gain, either on the part of the company as a whole or by specially interested individuals. In fact, care was taken in drafting the articles of organization to prevent one or a group of individuals from securing control, since it was deemed wise to have a thoroughly representative organ. The JOURNAL COMPANY has demonstrated the possibility of issuing this serial without financial loss. The question has been raised as to the advisabilty of the assocation taking over the JOURNAL and have the membership fee (the latter raised to $2 for active members, $1.50 for associate members and $1.00 for foreign members) include subscription to the official organ. Every economic entomologist should possess a copy of this publication. The wisdom of this will become much more apparent in subsequent years. Some amendment to the by-laws would be necessary if the change is made. This can easily be arranged by the secretary giving thirty days' notice of the proposed amendments. This change would render a publishing company unnecessary, give the association direct control of its official organ and effect an economy in the collection of subscriptions.

Reviews

RECENT WORK ON THE CODLING MOTH.—Three recent reports of investigations of the codling moth have added very much to our knowledge of the life history and control of this pest in Arkansas, Virginia and Georgia. These studies confirm observations made by others on the following points: Practically all eggs of the first generation are laid on the leaves; a larger proportion of the larvæ of the second brood enter at the side and stem; the drenching spray shows no

greater efficiency at 100 to 120 pounds pressure than the mist spray; late spraying applied so that the foliage is covered when the first eggs hatch destroys the first brood of larvæ very effectively, although not as well as the spray directed into the calyx.

These studies, particularly the first, show a marked advance in exactness of method in the study of the life history and the care with which spraying experiments have been arranged and form a most important addition to our knowledge of the subject. With the data which has been recently presented from various parts of the country a complete monograph of the life history and the means of control of the codling moth may now be prepared for the country as a whole and careful comparison and study will reveal not only most interesting differences in life history due to different climatic conditions, which will have a practical bearing upon means of control, but will also undoubtedly furnish a most interesting biological study in connection with the effect of climate on the number of generations, hibernation, etc.

The Codling Moth in the Ozarks, by E. L. JENNE, U. S. Dept. Agric., Bur. Ent. Bull. 80, Part I, p. 32, figs. 8 (June 26, 1909).

Mr. Jenne gives a report of the life history studies commenced in 1907 at Siloam Springs, Benton County, Arkansas. The account of the life history given is the most complete and satisfactory study of the life history of the codling moth for a given locality which we have seen. The arrangement is admirable, the data is well presented and full and when compared with that of previous years shows the seasonal variation in the life history. The spring pupæ occur from March 1 to June 1, the length of the pupal stage decreasing with the advance of the season, and the moths emerge from March 31 to June 8, the maximum emergence being on May 12, about a month after the apple blossoms dropped. The life of a moth averaged about ten days and the eggs were laid three to five days after emergence. The first brood of eggs commenced on April 7, were abundant by April 27, and the last were laid May 27. Practically all the eggs were laid on the leaves. Eggs laid on April 19 hatched in 19.6 days; those laid May 10 hatched in 7.5 days. The first larvæ were found April 27, three weeks after the apple petals fell. In 1907 they were found on May 18, or six weeks after the petals fell. The majority of the larvæ entered the fruit during May, this being due to the concentration of the first brood due to the shorter period of pupæ and eggs as the season advanced.

The first cocoons of the first new brood of pupæ were observed May 27 and the last on July 15. In 1907 the first cocoon was observed on June 12 and in 1906 on June 5. The average life of the first brood of larvæ in the fruit was 23.8 days. 7.2 days elapsed between the time the larvæ leave the fruit and their pupation. Thus the first brood of pupæ overlap the spring brood twelve days. An average of 10.7 days is passed by the first brood of pupæ. It should be noted that Mr. Jenne uses the term "brood" in speaking of any single stage of the insect and the word "generation" to include all stages of the life cycle.

The first larvæ, pupæ and moths in the spring are termed the spring brood and generation respectively and the first generation commences with the eggs laid by the spring moths. This nomenclature is somewhat different from that which has usually been used in discussing the life history of the codling moth and may tend to confusion, but is here followed. The first moth of the first brood emerged June 8, whereas in 1907 it emerged on June 25, and in 1906 on June 19. The moths of this generation lived 6.2 days.

Summing up, the life of the first generation from the time of oviposition to the emergence of the moths required an average of 54 days. The second brood of larvæ began to leave the fruit July 15 and the last of them left the fruit early in September. The average time in the fruit was 24.6 days, while in 1907 it was but 18.1 days, though the conditions were somewhat different. After leaving the fruit 11.8 days passed before the larvæ pupated. Very few larvæ pupated after August 20. The pupal stage averaged 10.5 days and the time in the cocoon 20.4 days. The second brood of moths commenced to emerge July 25, were abundant in August and diminished through September. The life cycle of the second generation thus required an average of 49.5 days, which, with 5 days before oviposition, makes a total of 54.5 days, as against 49 days in 1907. The first eggs of the third brood were laid August 5 and the last October 16 from a moth emerging October 1. All eggs laid before August 28 hatched in 5 days. In September the length of the egg stage lengthened to the maximum time for those in the spring. The first larvæ of the third brood occurred August 14 and began to leave the fruit September 2, having been 24 days in the fruit. All of these hibernated.

A few larvæ failed to pupate early in the season, but of the first brood there were three and of the second brood four larvæ which hibernated without pupating. In 1907 out of 41 larvæ 5 of the second brood failed to pupate. In 1908 the majority did not pupate after August 20 and all hibernated after September first.

There can be no question as to the correctness of there being three broods for three generations were reared from four eggs laid May 4. The band records showed that there were five times as many larvæ of the second brood as of the first brood, but that the third brood was hardly larger than the first, due to the early harvesting of the crop. This is an important factor in the control of the codling moth in southern localities or where early fruit is grown, the importance of which has not been usually noted and was evidenced by the rather small percentage of infestation, but 50% of Winesap apples and 60% of Ben Davis being infested on unsprayed trees.

Life History of the Codling Moth in Virginia, by J. E. Buck, Va. Agr. Exp't Station Rept. for 1908, p. 54–89; fig. 33–53.

The life history has not been so carefully studied by Mr. Buck in Virginia, but the report gives very valuable data and undoubtedly presents the most important data concerning the life history from a practical standpoint. Further life history studies with a larger amount of material carried on at the different latitudes in Virginia would make a most valuable addition.

The effect of birds in the destruction of winter larvæ was studied and it was estimated that 85% were destroyed by them. The spring pupæ were found March 28 and most of the larvæ had pupated by April 28. The earlier pupæ required about 30 days. The first moth emerged April 26 and the last June

1. the maximum emergence being about the middle of May. One moth lived 14 days, but the average was from 2 to 7 days in jars. More eggs were observed on the fruit than have been noted elsewhere, 25 being found on apples against 50 on leaves on May 25, but this count is hardly large enough to be conclusive. Blossoms dropped about April 30 and the first larvæ were found in apples about June 2, though a few entered earlier. Seventy-one per cent. of the larvæ entered the calyx, 21% entered the side and 8% at the stem. The first brood of moths occurred from July 4 to August 28, the maximum being about the middle of July and the maximum of the larvæ found under bands was July 13. Eggs were laid on July 15, 15 being found on leaves, 10 on apples. These hatched in five days. Sixty per cent. of the second brood of larvæ entered the side of the apples. Pupation stopped about August 8. The band records taken at Blacksburg, latitude 37.25 degrees, altitude 2,170 feet, show maxima at June 28 and July 30, while at Emporia, latitude 36.45 degrees, elevation 200 feet, the maxima were June 6 and August 5. A fuller study of the life history at these two points would therefore undoubtedly reveal important differences, with probably a third brood at Emporia. The observations on the life history were made at Blacksburg.

Well arranged spraying experiments were carried out on York trees with well planned plots and with both dropped and picked fruit recorded. 70.9% of the fruit was wormy on checked trees. The results indicate that 4 ounces Paris green was not quite as effective as 1¼ pound arsenate of lead. Drenching the trees with Bordeaux nozzles with 100 to 120-pound pressure with a barrel pump showed no benefit over a mist spray. A pressure gauge was used and a constant pressure maintained. Plots 15 and 16 were in a separate orchard of Ben Davis and so were not comparable with the previous plots. They were sprayed two to four weeks after the blossoms dropped. Six ounces of Paris green seemed to be of equal value to 2 pounds arsenate of lead. With 41.52% wormy on the check trees there were but 2.12% and 4.29% wormy on the sprayed trees and 1.86% and 4.56% of the picked fruit wormy. This indicates that the later spraying gave practically as large a per cent. of good fruit as the earlier spraying directed into the calyx.

The Codling Moth or Apple Worm in Georgia, by W. V. REED, Ga. State Bd. Ent. Bull. 29, March 15, 1909, p. 37; fig. 23.

Studies of the life history were made at Cornelia in 1906, Pomona in 1907, and Tallapoosa in 1908. In 1906 the spring brood of moths emerged, May 6 to 24, maximum May 12; in 1907 from April 25 to May 17, and in 1908 from April 9 to 26. These results are based, however, on but from 10 to 20 moths each season.

Eighty-nine per cent. of the first brood of eggs were laid on the foliage and 9% on the fruit in 964 eggs observed. The eggs of the first brood hatch in an average of 9 days. During July the second brood hatch in 5½ days. Mr. Reed has succeeded in rearing larvæ on leaves entirely and finds frequent evidence of their work on foliage in the orchard. Seventy-one per cent. entered the calyx, 16% the side, and 8% of the larvæ entered at the stems during the season. The average life of larvæ in the fruit was 28 days for the first brood, and from 13 to 36 days, averaging less than three weeks for the second brood. Most moths lived less than a week, though one lived 25 days, but he concludes that the average life is two to three weeks. Including 5 days from

emergence of moth to oviposition, the second generation requires an average of 48 days (35 to 65 days). A life history chart is given showing the development of three full generations and part of a fourth, this being based on continuous rearings throughout the season, but the discussion of the life history might well have been amplified. Mr. Reed concludes, however, that probably there are usually only three generations and sometimes only two and a partial third. Some larvæ of each brood fail to pupate and hibernate over winter.

Concerning spraying Mr. Reed states that on the proper time of spraying for the first brood hangs 78% of successful control for the season, although the second brood does more actual damage than the first brood.

Spraying experiments were carried on at Tallapoosa and Pomona. Unfortunately no records of dropped fruit were made and at Pomona only 500 fruit were counted from a single tree in each plot. The arrangement of the plots was also unsatisfactory, consisting of straight rows, side by side, so that there must have been considerable influence of one plot on another. Nor was the time of spraying well arranged to show the exact value of the early sprays after the first or the best time for their application. The first was given when the petals fell (April 6); second, before calyx closed (April 13); third, 10 days later (April 23); fourth, 14 days later (April 27); and fifth, when second brood eggs hatched (June 12); and two weeks later (June 26). Therefore the results of the spraying experiments can hardly be regarded as very conclusive, but studied in a broad way indicate the following results:

But little difference was indicated in the value of the first three sprayings, or whether applied just as the petals fell or a week later just before the calyx closed. Late sprayings for the second brood showed only 2 to 5% benefit, and when added to the early sprays increased their benefit by about the same amount. The practical value of spraying was well demonstrated, though the per cent. of perfect picked fruit was not as high as should be secured with thorough work.

E. D. SANDERSON.

Striped Cucumber Beetle, by T. J. HEADLEE, 19th and 20th Reports of the N. H. College of Agric. & Mechanic Arts, p. 419–513, 1908.

This is a most excellent general economic account of the striped cucumber beetle, one of the most important insects with which the American farmer has to deal. The writings of earlier authors are freely cited and comparisons are made, some of which are extremely interesting, *e. g.*, the periods the writer determined by rearing in the District of Columbia in a high temperature in comparison with those in New Hampshire at the naturally considerably lower temperature. In the former it was found that the pupal period could be passed in a minimum of seven days in a temperature of from 75° to 85° F., while in New Hampshire 13 days are required in a temperature of about 66° F. In regard to the total period of the life cycle, Garman, working in Kentucky, ascertained that this period from the hatching of the egg to the transformation to the adult averaged from 26 to 33 days, while in New Hampshire the life cycle was passed in an average of 54 days, at a mean temperature of 69° F. In New Hampshire it has been ascertained that the species is single brooded, but the writer still claims, until it can be otherwise proved, that there are at least two generations in the District of Columbia and perhaps three southward, this conclusion being based upon analogy. Some interesting

experiments were made with remedies, but there is still much to be learned in this line. In spite of the observations of Messrs. Sirrine and Headlee that this cucumber beetle is expert in avoiding poisoned portions of a plant, as good results have been obtained by others in the use of arsenate of lead as for the Colorado potato beetle. Trap crops are also valuable and additional experiments should be made with them. F. H. C.

Insect Friends and Enemies: The Relation of Insects to Man, to Other Animals, to One Another, and to Plants, with a Chapter on the War Against Insects, by JOHN B. SMITH. J. B. Lippincott Co., p. 1–134, 1909.

This popular work is a remarkably sympathetic and accurate discussion of the relationships between insects and their environment. The writer's extensive experience as a practical entomologist and his intimate knowledge of the literature have enabled him to produce a thoroughly modern and very readable and attractive book, covering certain fields which have not heretofore been adequately treated in popular literature. The various chapters, arranged largely along systematic lines, have for their chief purpose the exhibition of the numerous interrelations existing between the different insects and their relation to other organisms. The practical value of the book is greatly increased by numerous references to the more important injurious species for the purpose of illustrating the discussions. The chapters on insects in their relation to each other comprises a clear presentation of the value of parasites and incidentally summarizes certain recent biological discoveries. Birds come in for rather severe strictures on page 134, though the author admits their value under certain conditions and very properly regards them as but one of the natural checks on insect life. The treatment of insects in their relation to other animals, to man and the household is exceptionally full and is practically an economic discussion of the more important forms. The chapter on the war on insects is devoted mostly to insecticides and their application. The volume is illustrated with a large series of figures, taken mostly from the author's earlier publications, and an excellent plate (original) depicting in natural colors the chief insect pests of the household.

The general public will find in this volume a vast amount of interesting and valuable information respecting insects, while the investigator will frequently refer thereto because of the excellent summaries, especially of the recent investigations in regard to insects and their part in the dissemination of disease.

On Certain Seed Infesting Chalcis-Flies, by CYRUS R. CROSBY, C. Univ. Agric. Exp't. Sta. Bull. 265, p. 367–388, 1909.

This is an admirable investigation of minute, hitherto almost unnoticed forms, several of which are of considerable importance. A table showing the systematic position of the Phytophagous Chalcids is followed by historical, biological and descriptive accounts of several species, with special reference to methods of controlling the injurious or potentially injurious forms. The numerous illustrations are excellent and the author is to be congratulated upon making a substantial addition to our knowledge of this group.

Current Notes

Conducted by the Associate Editor

Prof. C. E. Sanborn has been appointed entomologist to the Oklahoma Agricultural Experiment Station. Address, Stillwater, Oklahoma.

Dr. A. W. Morrill, who has been engaged in White Fly investigations for the Bureau of Entomology in Florida, has resigned to become entomologist to the Arizona Horticultural Commission and the Arizona Agricultural Experiment Station.

Mr. Edward M. Ehrhorn, Deputy Commissioner of Horticulture of California, has resigned to accept the position of superintendent of entomology of the Hawaiian Board of Agriculture and Forestry. He took charge of the work at Honolulu October 1.

Mr. Jacob Kotinsky, who has been conducting the work since the death of the late Alexander Craw, resumes his post as assistant entomologist to the board.

Mr. M. M. High, a graduate of the Mississippi Agricultural College, has been appointed an expert in the Bureau of Entomology, United States Department of Agriculture. He will work on insects affecting truck crops.

Mr. S. S. Crossman, a graduate of the Massachusetts Agricultural College, has received the appointment of expert in the same bureau and has been detailed to work on White Fly investigations in Florida.

Mr. T. L. Patterson, a graduate of Clark College, Worcester, Mass., has been appointed an expert in the same bureau at the Gipsy Moth Parasite Laboratory, Melrose Highlands, Mass.

Mr. Dudley Moulton, who has been engaged in the investigation of deciduous fruit insects in California for the Bureau of Entomology, has resigned to become deputy commissioner of horticulture of California.

Dr. H. J. Franklin has resigned as assistant state entomologist of Minnesota.

The associate editor, owing to the editor being in Europe for several weeks, will edit the December number. It may save time to send all manuscript to the associate editor at the Gipsy Moth Parasite Laboratory, Melrose Highlands, Mass.

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ADDITIONAL NOTES UPON THE BREEDING OF THE COFFEE-BEAN WEEVIL

(*Aræcerus fasciculatus* De Geer.)

By E. S. Tucker, *Special Field Agent, Bureau of Entomology, Washington, D. C.*

Since my paper announcing the discovery of the attacks by the coffee-bean weevil in cornstalks was submitted for publication (27), observations upon the habits and life history of the insect under different conditions have been continued whenever possible, not only by myself, but by other agents associated with me in the cotton boll weevil investigation.

As a possible injurious insect of a very important staple crop, as noted in the case of corn, the coffee-bean weevil excites special attention. While no direct proof of adverse effect upon the development of the ears can yet be charged to this weevil, the nature of its work in attacking green stalks places it in an apprehensive attitude that will need close watching.

The observations concerning the breeding of the species in cornstalks during the winter and spring months have proved conclusively that it thrives without an interruption, although a large mortality of all stages was apparently caused by cold weather. On January 25 Mr. R. A. Cushman, while at Alexandria, La., found the weevils in all stages and their work generally occurring in old standing stalks in the field of their discovery. During an examination of the same field and others in the vicinity, made by myself on February 26 and 27, most stalks showed abundant evidences of work by the insect, although at this time the ground in all but two out of five fields on as many different plantations had been broken with middle-burster plows; and,

in consequence, the stalks on the plowed lands lay in pieces either on the surface or partly buried. The results of rigorous activity was displayed with the prevalence of live larvæ and pupæ in the damp buried parts of stalks, scarcely any dead stages occurring with them. With the dry uncovered or standing stalks, however, the exposure to freezing weather had evidently resulted in a large fatality, as most of the stages, including the few adults found, were dead Among the slight survival of stages above ground the pupæ exceeded in proportionate number, thus showing a superior hardiness of this stage. Some dead adults which were taken from standing stalks seemed to have perished suddenly when just ready for emergence, their bodies, in fact, filling the exit hole. The conclusion was reached that the conditions most favorable for survival depended upon the protection of earth, such as occurred with root stalks and buried pieces.

A diligent search was made to ascertain if the boll weevil might be found hibernating in the cavities formed by *Aræcerus fasciculatus,* or otherwise in split or hollow stems. Instead of finding any boll weevils, however, other insects were taken, among which were certain weevils that are apt to be mistaken by planters and field laborers for the cotton boll weevil. These in particular were the cow-pea pod-weevil (*Chalcodermus æneus* Boh.) and a common grain weevil (*Calandra oryzæ* Linn.). The failure to find a single boll weevil in the stalks at this time does not disprove its probable choice of this form of shelter, which may reasonably be expected to harbor this pest when in close proximity to infested cotton fields. In fact, cornstalks are known to afford very favorable hibernation quarters for the boll weevil, which, following after the ravages of *Aræcerus fasciculatus,* would find retreat doubly accessible.

To determine whether similar work by *Aræcerus fasciculatus* might be carried on in other localities of Louisiana an inspection of old cornfields was made at Mansura on March 1 and 2, which resulted in finding the same kind of invasion by the insects as at Alexandria. The opinion that such infestation was likely a matter of general occurrence was sustained by Mr. W. D. Hunter, who reported as an estimate that half of the stalks which he saw in the vicinity of Mansura, six days later, showed more or less injury, and with as many as five emergence holes appearing on a joint. Subsequently Mr. W. D. Pierce, while stopping at this place on a trip of inspection April 13, observed that the weevils were breeding abundantly in the same manner as noted before.

Since the facts had now determined an infestation of more than local extent, its significance applied prospectively to a large region in

which the climate and crop conditions offered corresponding inducements to the weevil, and naturally including southern Texas. To verify the part that Texas was expected to share, Mr. J. D. Mitchell inspected a number of old cornfields at Victoria, March 7 to 10, and in every one he readily found the weevil and evidence of its work. He estimated that not over 10 per cent. at most of the stalks were attacked. All of the information so far obtained, however, positively defined this newly-known habit of the weevil as an universal trait.

That this weevil is capable of breeding indefinitely in cornstalks was shown by its continuance of stages in the first collection of stalks obtained last year, on September 18, until the experimental test was purposely terminated on April 14 of the present year, covering a period of seven months; and, moreover, the insect has proven its ability to withstand the winter climate of Dallas, Tex., where the infested stalks were kept in a breeding box in an outdoor insectary. While the species has survived severer winter weather than where collected, no protection was afforded other than a dry screened cage under a roof.

In order to learn the particulars by personal observations concerning the reported attacks in green stalks, as mentioned in my previous paper (27), an inspection of the corn growing on the same plantation near Alexandria, La., where the weevils had been first detected in the rôle of a cornstalk pest, was made on August 3 of the present year. My search required only a few minutes at any place examined to obtain abundant evidence of the weevils' presence, though, contrary to expectations based on my first experience of last year, the lower joints instead of any above the ears were found attacked. Furthermore, the astonishing feature of their work was shown by severe attacks on the leaves. Upon stripping these leaves from the stalks the inner side of the base which encircles the stem above the node was found to be shredded with burrows, generally running in courses between the fibres, the work opening through the surface on account of the thin structure.

The finding of live larvæ occupying burrows in the damaged portions of the leaves clearly places the responsibility of the work upon this stage of the insect. Moreover, an adult was taken while resting on a blade. In the joints the larvæ were found embedded just under the surface at the node, the external effect being distinguishable by a blackened spot, indicating the point of entrance or oviposition. As the attacks occurred more commonly on leaves than stalks, the inference follows that the weevils first breed in the base of the leaves and later attack the joints, probably as each in turn begins to dry. On the whole, however, the stalks were in a green and sappy condition, some

still having fresh green leaves, although no leaf was found attacked except dried ones. Of course, from the nature of the attack, such leaves would dry prematurely, and to some extent injured stalks would be similarly affected. The infestation proved to be more prevalent in corn growing on land which had produced a like crop the year before and where old stalks remained than in fields on cotton land. Besides, the time of planting made some difference in the conditions of freshness in favor of the crop on the cotton land which was planted late. On account of unusual hot and dry weather the crop matured about one month earlier this year than ordinarily. If the weevil should attack stalks as early in the season on normal years as it has this year, the yield would naturally be expected to suffer from incomplete nourishment. To all appearances, no detrimental effect on this year's product could be charged to any cause other than to weather conditions in support of the claim of undersized ears. The chain of evidence in determining the attacks in green stalks, however, is further strengthened by the maturity of weevils from infested samples placed in a breeding box. At Tallulah, La., on October 1, two adults were found on drying stalks of late planted corn. Although I failed to find any signs of breeding in the stalks, their presence was considered to be for the purpose of oviposition.

As a cotton insect Dr. L. O. Howard has placed the species on record as attacking damaged bolls, and he also points out the principal adult characters by which it can easily be distinguished from the boll weevil, since both insects in one stage or another are sometimes found living in different parts of one boll (12, 13). Its work in this respect is much like a scavenger, or, as Doctor Howard states, a "result, rather than the cause, of the damage." Field observations have failed to bring to my notice any definite evidence of its attack in green bolls. That such instances seem possible in case of partially diseased bolls was indicated by finding at Jackson, Miss., on October 11, an adult hiding in an opening of a boll in which anthracnose had developed sufficiently to cause discoloration of the exposed internal tissues; otherwise the boll was green and unaffected. The intent of this weevil was surmised to be for oviposition, and at the same time to feed upon the decaying tissues. Definite cases of its breeding in bolls have been repeatedly carried through from larva to adult, but in every instance, the infested bolls were old deteriorated or dried rotten ones, the ravages occurring particularly as a sequence to the disease called anthracnose.

From collections of old cotton bolls gathered by myself at Alexandria and Mansura, La., February 26 to March 2, and by Mr. J. D.

Mitchell at Victoria, Tex., March 7 to 10, the dates being already stated for examination of cornfields, the weevil in all stages, mostly larval, however, was frequently encountered in both hanging and fallen bolls. Many of these bolls, including the seeds, were so completely riddled internally that only the burr prevented them from crumbling into dry powder. Larvæ in these bolls isolated for rearing matured as adults from March 24 until April 14. In the course of examination of the bolls from Alexandria, La., one fallen boll was found to contains a number of live mites with two dead pupæ of *Aræcerus fasciculatus.* The gregarious position of these mites within the nearly destroyed pupal bodies at once indicated their predaceous nature. These mites were identified by Mr. Nathan Banks as apparently his species, *Tyroglyphus breviceps.* This species of mite affords additional interest from the fact that it has been known at times to prey upon larvæ of cotton boll weevils in fields at Victoria and Calvert, Tex.

The persistency of *Aræcerus fasciculatus* in breeding in old cotton bolls was notably observed this year at Natchez, Miss. Mr. R. A. Cushman found all stages in dried and decayed seeds of bolls which he collected at this place on January 19. During the time of my assignment at Natchez, from May 11 until June 29, for the purpose of recording the appearance of boll weevils in hibernation experiments, adults of the coffee-bean weevil also appeared frequently with boll weevils in cages containing old plants with hanging bolls, and in one instance from Spanish moss alone in the cage. To prove that *Aræcerus fasciculatus* actually bred in the bolls at this time, an examination of a number of hanging and fallen bolls gathered from old stalks in an open space adjacent to the cages was made on June 8, and resulted in finding both larval and adult stages, many of the bolls showing severe ravages. A weevil matured in fourteen days from an infested boll placed in isolation.

An important factor which relates to the favorable propagation of the coffee-bean weevil is afforded by berries of the China tree, as formerly mentioned, (27). During my inspection work at Alexandria and Mansura, La., the overwintered Chinaberries also received attention, and the finding of larvæ commonly at work in them denoted a general infestation of the fruit. The abundance of these berries which remained hanging on the trees therefore provided an attractive medium for the breeding of the weevils. Not only as an alternative, but in case of destruction or absolute lack of cornstalks and cotton bolls, the weevil will evidently maintain a prolific multiplication in Chinaberries. Mr. J. D. Mitchell has reported the emergence of an adult weevil from a Chinaberry as early as February 28 at Victoria, Tex. On May

27, at Natchez, Miss., I found two fresh-looking adults clinging to stems of fallen berries, from which they had probably just emerged, and a young larva found at the same time in a berry selected from other infested ones matured June 17 in isolation. Few larvæ were found in old fallen berries at Tallulah, La., on October 1.

An additional food-plant, concerning which no former record is known to me, has been reported by Mr. J. D. Mitchell, who submitted an adult weevil with the statement that it emerged on February 21 from castor bean (*Ricinus communis* Linn.), collected December 21 at Victoria, Tex. At Baton Rouge, La., on April 13, Mr. W. D. Pierce obtained an adult and larva in an old rotten fig, which had been hanging on the tree, but earlier mention of the weevil's depredations in fig products has been made by Mr. E. Barlow with respect to Chinese figs, (1), and by Dr. F. H. Chittenden in regard to fig cakes, (7).

The statement previously made regarding its breeding in beans is applicable to such as possess aromatic properties. Dr. F. H. Chittenden, who bestowed the common name of "Coffee-bean weevil" upon the insect, is the leading authority upon the omnivorous habits of the pest in attacking vegetable substances, (5, 6, 7.) Being transported in tropical products the insect has become cosmopolitan as an indirect result of world-wide traffic, thus accounting for its introduction into the United States. The immature stages, as a rule, are pure white, although generally covered with the fine powdered debris of the burrow; but occasionally in the cornstalks and rarely in cotton bolls pink colored examples of both larvæ and pupæ were found.

Literature Consulted

1. **Barlow, E.** Notes on insect pests from the entomological section, Indian museum. (Indian Museum Notes, IV, No. 3, Govt. India, Dept. Rev. and Agric., 1899, pp. 125–127, pl. XI, fig. 3, larva, pupa, dorsal and side views of adult.)

   Called the areca-nut beetle from its attacks in stored nuts of *Areca catechu*, or betel-nut. Mentioned as attacking coffee-berries, ginger, Chinese figs, etc. Article ends with synonymy by Doctor Gemminger et B. de Harold, Catalogus Coleopterorum.

2. **Beutenmuller, Wm.** On the food-habits of North American Rhyncophora. (Jour. N. Y. Ent. Soc., I, 1893, p. 88.)

   Quotes Mr. E. A. Schwarz's record, see 25.

3. **Blackburn, T., and Sharp, D.** Memoirs on the Coleoptera of the Hawaiian Islands. (Sc. Trans. Royal Dublin Soc., III, ser. II, Feb., 1885, p. 260.)

   "Widely distributed. Common in decaying leaves wherever they are heaped up from any cause, and occasionally beaten from fresh

foliage. Very variable. This insect has no saltatory powers whatever."

4. **Brown, R. E.** Strychnine as food of *Arœocerus fascicularis* De Geer. (Jour. N. Y. Ent. Soc., XIV, 1906, p. 116.)
 Reported breeding in the St. Ignatius bean (*Strychninos ignatii*) in the Philippines.

5. **Chittenden, F. H.** Insects affecting stored cereal and other products in Mexico. (Bull. 4, Tech. Ser., Div. Ent., U. S. Dept. Agric., 1896, p. 30.)
 Mentioned as "coffee-bean weevil," with the statement that it is disposed to be omniverous, being known to breed in raw coffee-berries, cacao beans, mace, nutmegs, cotton bolls, the seed pods of the coffee weed (*Cassia*, sp.), and a plant called wild indigo, probably a species of Indigofera. Well known throughout the cotton states and sometimes found in the northern states in articles of commerce.

6. ———. Insects affecting cereals and other dry vegetable foods. (Bull. 4, n. s., Div. Ent., U. S. Dept. Agric., 1896, p 129; also Rev. Ed., 1902, p. 129.)
 Name proposed as "coffee-bean weevil." Infesting dried apples, also coffee beans, mace, nutmegs, chocolate beans and roots of ginger.

7. ———. An invasion of the coffee-bean weevil. (Bull. 8, n. s., Div. Ent., U. S. Dept. Agric., 1897, pp. 36–38, fig. 9, larva, pupa and adult.)
 The species found to have been introduced in a grocery store of Washington, D. C., from coffee in sacks, the insects afterwards entering boxes of dried fruits and into crackers, especially fig cakes, breeding freely in dried apples. Mentions cotton bolls as food; also all stages in dry orange from Florida. Gives reference to original spelling of generic name.

8. **Fullaway, D. T.** Insects of cotton in Hawaii. (Bull. 18, Haw. Agric. Exp. Sta., 1909, p. 24, fig. 16, larva, pupa and adult of coffee-bean weevil, from Chittenden.) Mentions the species as "found about cotton, probably seeking shelter," and quotes Dr. L. O. Howard's reference.

9. **Giffard, W. M.** Presidential address. (Proc. Haw. Ent. Soc., I, pt. 5, April 8, 1908, p. 181.) Mentioned as an introduced species. "Beaten from Kukui" (*Aleurites moluccana*).

10. **Glover, T.** Entomological record. (Monthly Rept. U. S. Dept. Agric. for August and September, 1872, p. 367, fig. 13, larva and adult.)
 Referred to as *Arœocerus coffeæ* Fab. and reported breeding in decaying peaches from Baton Rouge, La.

11. ———. Report of the entomologist and curator of the museum. (Rept. U. S. Com. Agric. for 1872, p. 114, fig. 3, larva and adult.)
 Reference same as 10.

12. **Howard, L. O.** The insects which affect the cotton plant in the United States. (Bull. 33, Office Exp. Sta., U. S. Dept. Agric., 1896, p. 348.)
 The author in his account of the "Insects Injuring the Boll" says, "Among these the larva of a little weevil, *Arœcerus fasciculatus*, de-

serves especial mention for the reason that it so closely resembles the larva of the Mexican cotton-boll weevil."

13. ———. Insects affecting the cotton plant. (Farmers' Bull. 47, U. S. Dept. Agric., Jan., 1897, p. 29.)

Reference same as 12.

14. **Hunter, W. D., and Hinds, W. E.** The Mexican cotton boll weevil. (Bull. 45, Div. Ent., U. S. Dept. Agric, 1904, p. 49, pl. XV, fig. 62, larva, pupa and adult, from Chittenden.)

Entered in list of "Insects often mistaken for the boll weevil," under the common name of "Coffee-bean weevil," the usual food being given as "coffee beans and old cotton bolls."

15. ———. The Mexican cotton boll weevil: A revision and amplification of bulletin 45, to include the most important observations made in 1904. (Bull. 51, Bu. Ent., U. S. Dept. Agric., 1905, p. 67, pl. XI, fig. 49, larva, pupa and adult, from Chittenden.)

Reference similar to 14.

16. **Koebele, A.** Report of entomologist. (Rept. Com. Agric. and For., Ter. Hawaii, 1900, p. 43.)

"A large number of a very common beetle, *Arœocerus fasciculatus* De G., previously bred on coffee cherries from Waianae, also on seeds of koa, the mamani, and many others; even a seed pod of the kola nut produced quantities of this beetle that will breed equally as well in dead wood."

17. **Perkins, R. C. L.** Coleoptera, Rhyncophora, Proterhinidae, Heteromera and Cioidae. (Fauna Hawaiiensis, II, pt. III, Feb. 8, 1900, p. 182.)

Remarks as follows: "Hab. Abundant all over the islands in the mountains. The large number of constant varieties in markings, as well as the great variation in size of this species is remarkable."

Follows with description of *Arœocerus constans*, sp. nov.

18. ———. Injurious and beneficial insects. (Rept. Gov. Ter. Hawaii, 1902, p. 32.)

"Destroying seeds of many forest trees, e. g., koa, mamani, etc.; also in coffee berries. No natural enemies known here."

19. **Pierce, W. D.** On the biologies of the Rhyncophora of North America. (An. Rept. Neb. St. Bd. Agric. for 1906-07, p. 295.)

Refers to Mr. R. E. Brown's record, see 4, and adds: "This species has many host plants."

20. ———. A list of parasites known to attack American Rhyncophora (Jour. Econ. Ent., I, No. 6, 1908, p. 389.)

Lists the species as one of economic importance and as serving as co-host of boll weevil parasites.

21. **Riley, C. V.** Cotton culture and the insects affecting the plant at Bahia, Brazil. (Amer. Ent., III, May, 1880, pp. 128-129.)

Reports *Arœcerus fasciculatus* in cotton bolls forwarded from Bahia, Brazil, January 12, 1880.*

*A subsequent record in the entomological files of the U. S. Dept. Agric., under accession No. 2218, states that weevils matured in diseased bolls from Bahia, Brazil, November 13, 1882.

22. ———. The final report on the cotton worm, together with a chapter on the boll worm. (Fourth Rept. U. S. Ent. Com., 1885, note 62, p. [121].)

Remarks reproduced from 21.

23. ———. The insects occurring in the foreign exhibits of the World's Columbian Exposition. (Insect Life, Div. Ent., U. S. Dept. Agric., VI, February, 1894, p. 221.)

"Breeding in mace from Trinidad and Johore, and in cocoa beans from Liberia."

24. **Sanderson, E. D.** Insects injurious to cotton. (Insects Injurious to Staple Crops, 1902, pp. 200–201.)

Mentioned as attacking damaged bolls.

25. **Schwarz, E. A.** The Coleoptera of Florida. (Proc. Amer. Phil. Soc., XVII, 1878, p. 469.)

"*Aræocerus fasciculatus*—not rare, raised from the pods of a large yellow flowering shrub belonging to the Mimosaceæ."

26. **Smith, J. B.** Insects of New Jersey. (Supp. 27th An. Rept. St. Bd. Agric. N. J., 1899 [1900], p. 367.)

"Undoubtedly brought into the state on dried fruits and similar stores (Ch)."

27. **Tucker, E. S.** New breeding records of the coffee-bean weevil. (Bull. 64, pt. VII, Bu. Ent., U. S. Dept. Agric., August 5, 1909, pp 61–64, pl. III, work in cornstalks, and fig. 18, larva, pupa and adult, from Chittenden.)

Injury to corn; occurrence in Chinaberries; parasites; habits in general.

28. **Van Dine, D. L.** Report of the entomologist. (An. Rept. Haw. Agric. Exp. Sta. for 1907, p. 48.)

Under subhead of "Stored Products" the following records are given: "A beetle (*Aræocerus fasciculatus*) was bred from the seeds of St. John's bread (*Ceratonia siliqua*) received from Kohala, island of Hawaii. This same beetle was bred from cotton bolls received from Kona, island of Hawaii."

29. **Van Dine, D. L.** Report of the entomologist. (An. Rept. Haw. Agric. Exp. Sta. for 1908, p. 31.)

"A weevil (*Aræocerus fasciculatus*). This weevil was bred from cotton bolls received from Hookena, South Kona, Island of Hawaii, in December, 1905. Determined by Mr. E. A. Schwarz of the Bureau of Entomology."

NURSERY INSPECTION IN NORTH CAROLINA

By Franklin Sherman, Jr., *Entomologist, State Department of Agriculture, Raleigh, N. C.*

North Carolina does not take high rank as an orchard state, nor does she rank high in the number or average size of her nurseries. There has been an increase in the number of nurseries during the past decade. In 1900 there were forty-five licensed, in 1908 there were sixty-two licensed, but for the present season the number has dropped to fifty-six, with perhaps one or two yet to be added. Every year a few small nurserymen quit for one reason or another, and others start up. Of course our larger nurseries are permanently established and have considerable capital invested, but we probably have a larger proportion of small, temporary nurseries than is found in most states. However, this may be more apparent than real, due to the fact that we have continued the same system and policy of inspection so long that we have located and listed practically all nurseries even to the smallest ones which serve only a local trade and never offer shipments for transit by railways, etc.

We, like others, are frequently vexed to decide just "what is a nursery" and to tell whether this or that person's premises should be inspected. Often the expense and time required to make an inspection are so great as to be out of all proportion to the importance of the end served by it. In accord with the ideas which the writer has advanced at meetings of the horticultural inspectors we are constantly striving to eliminate needless inspections, needless expenses, and needless hampering of trade, as we believe that it is just such matters that cause some nurserymen to condemn the whole system of inspection as useless.

Our system of nursery inspection and control is very far from perfect. While our conditions of work are all that could be desired in almost every other particular, we are handicapped by the fact that we have only one man (Mr. S. C. Clapp of this office) to assign to the inspection work, and our funds are such that we cannot spend as much on the inspections as would be required to absolutely clinch their efficiency. We do not put a man out of business because his stock is infested with San José scale, and we state this fact plainly to our public. We destroy all trees that are seen to be infested in a *careful inspection,* and if the number is very small in comparison to the number of trees involved the nursery is certified. If the number found infested is large enough to throw suspicion on the whole lot

the block is examined *tree by tree*,—or is left over for a second inspection later, the proprietor being fully instructed what he is to do about it in the meantime. There is no charge for the one (first) regular inspection, but when second inspections are necessary there is a sizable fee, graded according to the acreage involved in difficulty, so the whole tendency is for the nurseryman to see to it that a second inspection will not be required. If a block is found to be so infested that even tree by tree inspection would still be insufficient, the block (or part of it) is condemned to complete destruction. Now right here comes a point,—how do we *know* that the condemned stock is destroyed? Well, here we are guided by circumstances. If the block is very small the inspector can cut off every tree row by row with his heavy pocket knife (which is always carried for the purpose); or he can stay on the premises while the laborers do the work of destruction by this means or otherwise. Or if the condemned block is large he may go his way and return later to see that the work has been done. If the nurseryman is one whose whole past record and conduct gives guarantee of his integrity the inspector may leave it to him to destroy the stock, the nurseryman writing us when the work has been done and we take his word for it. In case of doubt about the work having been properly done the inspector makes another visit to make sure.

It should be remembered that all stock of apple, peach, pear, plum, cherry, quince and apricot is required to be fumigated with hydrocyanic acid gas before it is sold from any nursery in the state, and all our nurseries are required to maintain suitable boxes or rooms for the fumigation, and every nurseryman is furnished with explicit printed instructions on the fumigation process, these instructions also indicating the amounts of cyanide, acid and water required for the particular box or room of the nursery to which sent. So the fumigation comes in as an additional safeguard after the other conditions have been met.

It is only in the more important cases that we arrange to have the stock fumigated personally by someone from this office. The great bulk of our nurserymen do their own fumigating, the inspector giving them any needed instructions at time of inspection. It is true that there is chance for stock to be sold without having been fumigated, but we believe that our nurserymen on the whole do reasonably well in meeting this requirement.

Now a word as to the qualifications of the inspector himself. It goes without saying that he should be able to recognize the more important insect and fungous pests that are liable to be in the nursery. We all recognize this as a prime necessity in meeting the *entomological* and *pathological* requirements of the situation. Should he not also be

well acquainted with nursery practices, customs, etc., so as to make only such demands as are practicable from the *nursery* standpoint? We all know that it is difficult to so conduct our inspections and so word our certificates that all kinds of stock shall always be properly covered by certificate,—there is so much of buying and selling, trading, dealing, one nursery growing stock for another, agents carrying over refused stock, etc., etc. I fear that those of us who make our inspections with an eye to their efficiency from the entomological viewpoint solely often make demands of our nurserymen that are well nigh impossible to meet in commercial practice. We are properly sensitive if persons in any other walk of life intrude themselves or their ideas into our affairs, for we maintain that such persons do not know what really is or is not practical in entomological work. Is there not reason for us to be careful that we in looking after the one question of insect pests do not give the nurserymen just cause to resent our inspection work? This idea has grown on the writer year by year,—while we were adhering to the custom of doing the work in person or having only technically trained assistants (college men) to do the inspection work. When it became necessary some two years ago to secure an inspector a young man was selected who had five years' actual experience in a commercial nursery, and who therefore knows the conditions of nursery work and trade, can recognize varieties in the nursery row, and is thoroughly familiar with all the practices common to the nursery business. This man was already familiar enough with San José scale to be a good inspector, and with very little further study and experience has developed into a good all-round man in nursery and orchard inspection work, spraying work, etc. It strengthens our work among the nurserymen if our inspectors show a practical familiarity with the nursery business, in addition to being expert in detecting insect and fungous troubles.

It has been our endeavor to cut out all the immaterial, unimportant details and center our efforts on the main points that are at stake in the nursery inspection, and we have tried to make both our work and its requirements more simple and more effective year by year. We find that the proportion of nurseries found to be infested by San José scale is slowly increasing, and this seems to be inevitably the case through most of the eastern states, but we can at the same time assert that the average condition of the infested nurseries is becoming better year by year.

There are a few who still regard the inspection as a mere matter of form, but they are mostly growers of ornamentals, berries, etc., to whom the inspections do not apply so exactingly, or else they are

uneducated nurserymen who have not yet been brought squarely against the scale problem. The feeling of real respect (not merely tolerance) toward the inspection work in this state was never so great as it is at present.

PLANT LOUSE NOTES, FAMILY APHIDIDAE

By C. P. Gillette

Subfamily *Lachninæ*

Phyllaphis fagi L. At Lansing I found this species extremely abundant. Large American beech trees (*Fagus ferruginea*) had more than half their leaves closely rolled in from the sides by the pale yellow apterous form, the individuals of which were very nervous and active when disturbed. Each louse dragged about four long wavy threads of white secretion. No alate examples could be found. At City Park, Albany, a week later, the same species was seen infesting the underside of every leaf upon trees of the European beech (*F. sylvatica*) of both the green and purple varieties, but in no case were the leaves curled at all. I have never seen trees worse infested with plant lice than were these beeches. A few alate lice were taken at Albany. See figure 1.

Lachnus agilis Kalt. From pine leaves in City Park, Albany, New York. Both alate and apterous forms of this louse were taken. Lice very active and difficult to capture. *Winged viviparæ:* Body 1.70, wing 2.12, antenna 1.30, hind tibia 1.60 millimeters in length. Antennæ and all tibiæ set with numerous long stout hairs. For antenna and hind tarsus see figures 2 and 3.

Lachnus sp., near *agilis*. Taken at same place and date as the preceding on spruce. *Alate viviparæ:* Length of body 2.40, antenna 1.12, wing 3.30 millimeters; beak reaching well past 3d pair of coxæ; hairs upon tibiæ and antennæ more numerous than in case of *agilis* but the hairs are much weaker. Joint III with a single row of 4 tuberculate sensoria, IV with 1, V with 2. See figure 4.

Lachnus sp. A very small, powdery species rather common in rows upon pine needles at Washington, D. C. *Alate viviparæ:* Length 1.40, wing 2.34, antenna .90, hind tibiæ .86 millimeters; hairs of antennæ and legs long, pilose and rather abundant. Joint III of antenna with 8 sensoria; IV with 2; V with 1. See figure 5.

Melanoxantherium flocculossum Weed. Taken at Webster, Mass., and Portland, Ore., from the bark of willows. Both alate and apterous viviparæ. The peculiar weak cornicles, small at base, a

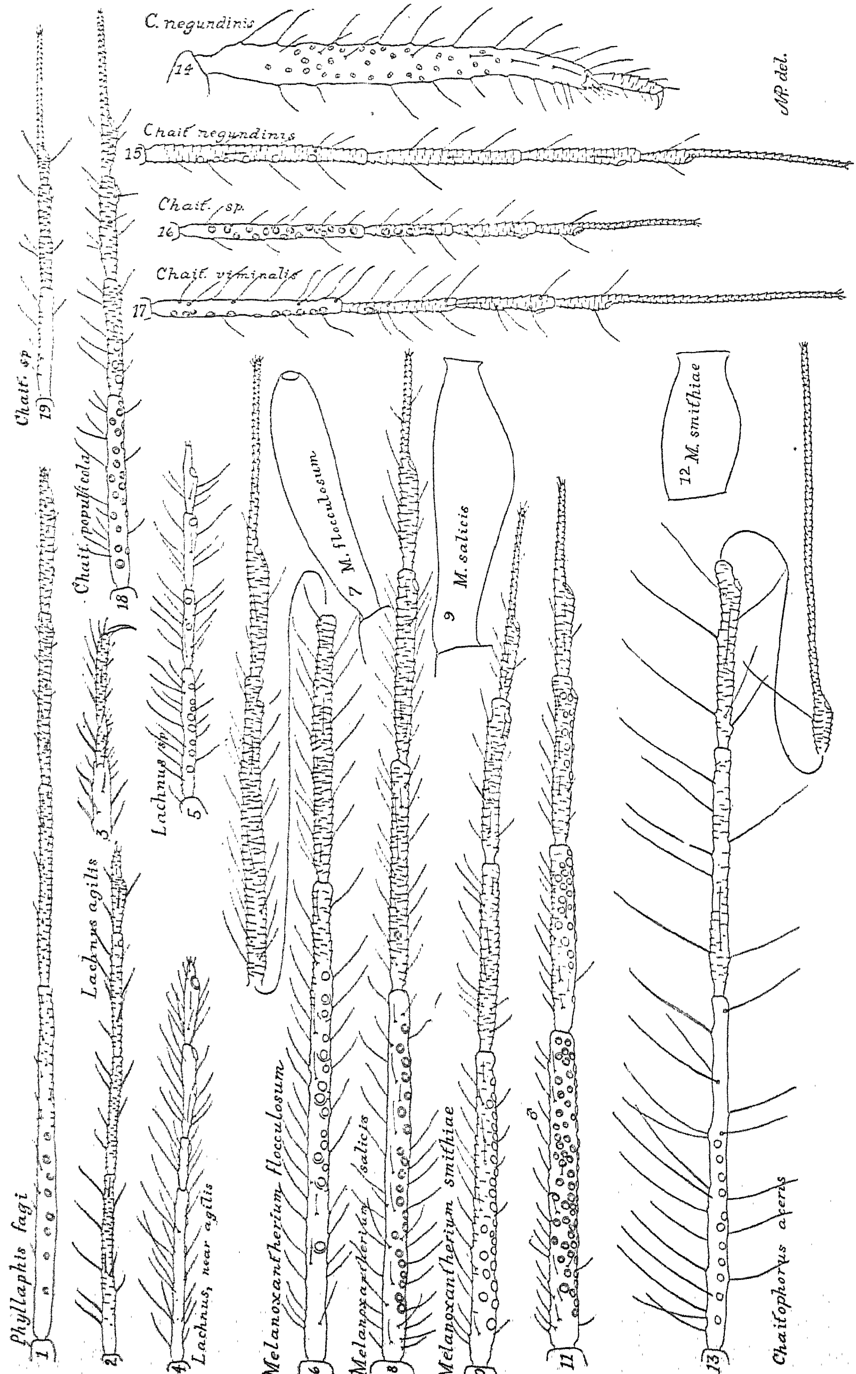

Plate 13.—Some antennæ, cornicles and tarsi of aphids

little larger in the middle and tapering to a rounded distal end entirely without flange, and the two longitudinal rows of conspicuous black spots upon the dorsum are striking characters of this large louse. It seems not to occur in Colorado. See figures 6 and 7.

Melanoxantherium salicis Linn. This species was taken by Mr. Bragg at Webster and Springfield, where it was feeding upon the bark of willows. Both alate and apterous viviparæ were in the lots taken. The only record we have for this species in Colorado is upon a few specimens taken by Mr. Bragg at Colorado Springs from willow. In general appearance this louse would be readily mistaken for *smithiæ* Monell. For characters of antennæ and cornicles of alate viviparæ see figures 8 and 9.

Melanoxantherium smithiæ Monell. This bark feeding louse was taken at Webster and Springfield where it was abundant on willow limbs. This is a very common species in Colorado, where it is always found feeding upon the small limbs. It is separated at once from any of the other species of this genus that I have seen by its very stout cornicles which are swollen in the middle and contracted at both ends. See figures 10, 11 and 12.

Chaitophorus aceris Linn. This species, so common upon the leaves of the sugar maple in the Central and Eastern states, I have never seen in Colorado. It was taken at Chicago, Lansing, Detroit, Geneva, Albany and Fort Lee. Both alate and apterous viviparæ were seen in each locality. See figure 13.

Chaitophorus negundinis Thos. This species, which is abundant upon boxelder, *Rulac negundo*, wherever the tree is planted upon both Atlantic and Pacific slopes in Colorado, was taken on this tree at Lansing, Albany, and Webster. Notice the peculiar double sensoria of the hind tibiæ of the oviparous female as shown in figure 14. The antenna of the alate viviparous female is shown at figure 15. The

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EXPLANATION OF PLATE 13.

1. *Phyllaphis fagi*, alate, Albany, July 1; 2 and 3, *Lachnus agilis*, antenna and hind tarsus, Albany, July 1; 4, *Lachnus*, near *agilis*, alate, Albany, July 1; 5, *Lachnus* sp., alate, Washington, July 3; 6 and 7, *Melanoxantherium flocculosum*, alate, Webster, July 16; 8 and 9, *Mel. salicis*, alate, Springfield, July 14; 10, 11 and 12, *Mel. smithiæ*, antenna of alate viviparæ, alate male and cornicle of alate viviparæ, Fort Collins, Colo., September 21; 13, *Chaitophorus aceris*, alate, Chicago, June 23; 14 and 15, *Ch. negundinis*, hind tibia of oviparous female, Fort Collins, November 16, antenna, Fort Collins, June 16; 16, *Chaitophorus* sp., alate viviparæ, Portland, Ore., August 22; 17, *Ch. viminalis*, alate, Georgetown, July 5; 18, *Ch. populicola*, alate, June 26; 19, *Chaitophorus* sp., apterous, Geneva, June 29. All figures enlarged 60 diameters. Original. Miriam A. Palmer, Delineator.

latter was taken November 16, and the former June 16 at Fort Collins, Colorado.

Chaitophorus sp. About Portland, Ore., and especially along the river from Portland to Oregon City, a species of *Chaitophorus* was common upon the leaves of the native vine maple, *Acer circinatum.* The lice seen were mostly apterous viviparæ and dimorphs. The latter were distributed along the main veins of the leaves and upon the wings of the fruit. Most of the dimorphs were decidedly yellow in color but some were growing preparatory to molting and these were quite dark, almost black. Some small very dark lice upon the leaves were probably shed dimorphs.

The apterous viviparæ are very similar to *negundinis* in general appearance except that they are almost black in color.

This louse is certainly not *negundinis* and I can not make it seem possible that it is *aceris.* The antenna is shorter and the filament much shorter in proportion (see fig. 16) and I can not find more than 20 flabellæ in any of the dimorphs, the more common number seems to be 18, or even 16.

Chaitophorus viminalis. At Chicago, Geneva, Webster and Georgetown, both alate and apterous viviparæ were taken upon willow leaves. This species was specially abundant at Geneva. It is an abundant species in the vicinity of Fort Collins almost every year. This species seems to be separated from closely allied forms by the unusually long antennal filament. See figure 17, which shows the antenna of an alate female.

Chaitophorus populicola. Taken at Portland, Michigan and Fort Lee on aspen, *Populus tremuloides.* This is a very abundant species in Colorado, at least to 9,000 feet altitude, upon the cottonwoods and aspens. Upon the aspens in the foothills the apterous viviparæ are almost entirely shining black in color. They often attack the tender ends of twigs in such numbers as to kill both the leaves and new growth. See figure 18.

Chaitophorus sp. A small yellowish green *Chaitophorus* with head a little dusky, was fairly common upon the under side of the leaves of *Malva rotundifolia* on the grounds of the Experiment Station at Geneva. Apterous viviparæ only were seen. The body length varies between 1.10 and 1.25 mm, and the antennæ between .77 and .90 mm in the specimens taken. The species seemed rather sporadic in habit. The antenna of an apterous female is shown at figure 19.

A NEW INSECTARY

By E. Dwight Sanderson, *Durham, N. H.*

At the last annual meeting of the Association of Economic Entomologists[1] the writer led a discussion as to the necessity of a glasshouse insectary for most life history studies. Although appreciating the necessity of a glasshouse for purposes of instruction and for certain classes of entomological investigations he has felt for some time that a structure which would give more natural conditions would be much preferable for most life history work. Carrying out this idea, an insectary was erected by the New Hampshire Agricultural Expermiment Station during the past summer, which is illustrated herewith, and whose construction may be of interest.

It was necessary to build the house on a side hill so that some filling was required and the outer end of the house is several feet above the surrounding area. This is a disadvantage which should be avoided where possible. A stone wall foundation, eighteen inches deep by twelve inches thick, was laid for the base of the entire house, which is thirteen by twenty-four feet. At the head end is a permanent wooden workroom, six by thirteen feet. A door enters from outside on the east side and another opens to the rearing room on the south side. On the north and west sides are windows. This gives ample room for one or two work tables, shelves, storage, etc. The walls are made of seven-eighths boards one foot wide, with three inch battens over the cracks, and the roof is covered with a gravelled roofing paper. All windows and doors are screened.

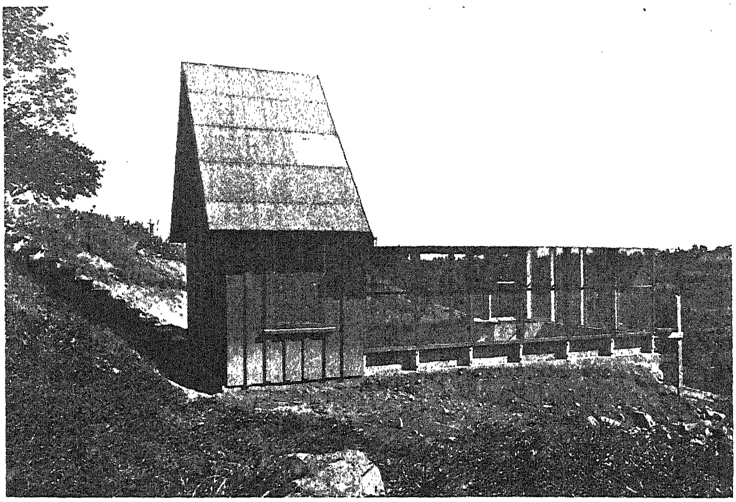
The rearing room has a cement floor through the center, with six cement pits down one side, and a strip of soil two feet wide along the opposite wall. The floor slants so that water runs out through a drain at the further end. The inside of each pit measures about two feet eight inches square and the outer walls are eighteen inches high. There are no bottoms to the pits so that when filled with soil they are continuous with the soil beneath. The sides of the rearing room are composed of 18-mesh, bronze screens, three feet wide and five feet high, resting on a cement coping, which are buttoned to the uprights which support the roof. The uprights of the sides are bolted to the cement coping and the framework for the roof is fastened together with bolts and screws, so that the whole structure may be taken down, stored for the winter, and readily erected again in the spring. The canvas roof is double, the ridge of the lower one being

[1]Jour. Econ. Ent., II, 59.

about eight feet above the floor and the outer one about eleven feet, giving a one-half pitch. The outer roof is of the heaviest sail cloth, while the inner is of twelve ounce canvas. This arrangement prevents any leaking through the outer roof, on account of the strong pitch, and cuts out the heat of the sun, by the air current between the two. The lower roof also protects the upper from the strain of the wind coming through the screen sides. At the outer gable end the gable is covered by canvas down to the screens. Each roof is really a fly, with a broad seam on each side through which a strip is run and is then screwed to the sides, thus affording a means of tightening the roof should it stretch. After four months, with many heavy winds, the roof shows no signs of wear. The spaces between the upright supports for the roof are filled in between the roofs so that the rearing room is absolutely tight for all ordinary insects too large to pass through an 18-mesh screen.

It is believed that this house affords as nearly natural conditions as possible consistent with an enclosure. Insects which pass the winter in the soil may be reared in cages placed on the pits or in cages on the soil side of the floor, and left there throughout the winter under normal conditions and cages then placed over them when the house is erected in the spring. Many of the details of construction, and indeed the whole house, must be regarded as an experiment, but from the experience of the Bureau of Entomology with more temporary structures in their work at the Gypsy Moth Laboratory at Melrose Highlands, Mass., it is believed that the general principles upon which the house is based are worthy of such a trial as they will now have.

The whole structure cost approximately $400. Of this nearly one-third was for the grading and cement work. About one half of the total cost was for labor and one half for materials. The double roof cost $47. The screens, including two doors and two window screens for the workroom, with the sixteen around the rearing room cost $70. Lumber cost about $50. Where no gradings were necessary and where a house could be built from plans previously developed, ours developed as we progressed, such a house could probably be built for $300. We shall be glad to furnish any further details of structure to any who may be interested.



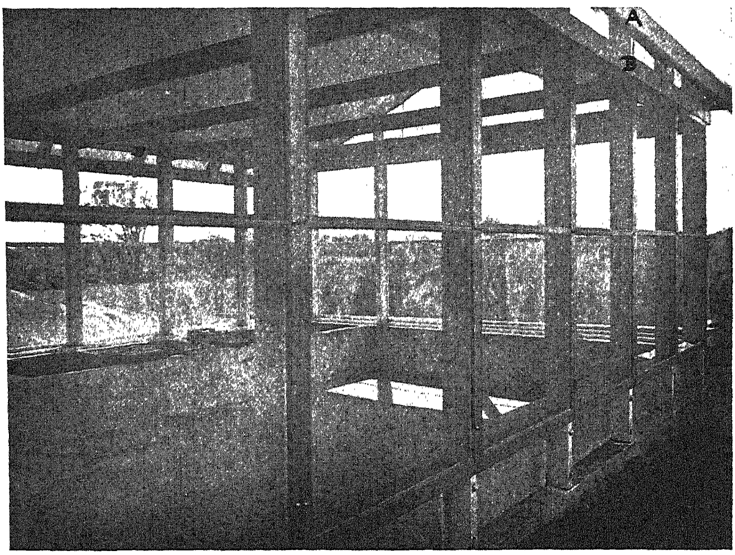


PLATE 14.—Insectary building of New Hampshire Agricultural Experiment Station. A and B strips passing through seams of canvas of upper and lower roof.

THE OBLIQUE-BANDED LEAFROLLER

Archips rosaceana Harris[1]

By E. Dwight Sanderson and Alma Drayer Jackson

In July, 1909, our attention was called to a case of very serious injury caused by the Oblique-banded Leafroller in a large rose house at Madbury, N. H. This is one of the largest rose conservatories in the country, the two houses having a total length of nearly one-half a mile and covering three acres. The roses on one or two benches had been entirely defoliated for over 200 feet as shown in Plate 15. Brief reference to entomological literature gave practically no information of value concerning the pest, so that an investigation was commenced at once. Mrs. Jackson kindly took entire charge of the rearing work and is responsible for the account of it, while the senior author is responsible for the rest of the present article.

History

This insect is an interesting example of one of our best known and much be-written species about which there seems to be but little information. Among the sixty-eight references given in the bibliography, less than a dozen give any very original information of any importance. The great bulk of the literature is mere compilation and quotation from Harris, the original describer. Coquillett seems to have made the most observations upon the species, but not until 1903 were the eggs briefly mentioned by Hart, and no one seems to have observed the stage which passes the winter. The insect has been a common one thruout the United States and, as the bibliography shows, has been noted for over half a century wherever entomologists have been located.

Injury

Serious injury by it has, however, been only occasionally reported. In 1894 Fletcher reported injury to the foliage and young fruit of pears in Ontario. In 1895 Piper noted considerable injury to prunes in Washington. In 1896 Lintner recorded serious injury to apple foliage and by the larvæ gnawing into young apples in eastern and central New York. The same year Lugger reported that Russian apples are sometimes defoliated by the caterpillars in Minnesota. No very serious injury to roses was noted until Chittenden in 1903 mentioned a case in which roses received from Ohio at Libonia, Pa., in

[1]Moths were determined for us by the courtesy of Prof. C. H. Fernald.

May, 1898, were badly infested, though Smith (1896), Davis (1897), and many others had mentioned the rose as one of the common food plants.

In the case under our observation the pest was received on some Killarney plants imported from an Ohio firm something over a year ago. The larvæ evidently increased during the summer of 1908 and by midsummer of 1909 were sufficiently abundant to cause very serious devastation, the loss from defoliation and incidental checking of blooms undoubtedly amounting to over five thousand dollars. Fortunately the infestation started in one corner of the house and though when first observed by us both houses were well infested thruout, defoliation was confined to a relatively small area and the slowness of the spread was rather remarkable. When first observed most of the terminals had been folded up by the larvæ. Subsequent observations show that where the larvæ are not numerous that they are much more common on the lower leaves than on the terminals, this doubtless being due to the fact that the eggs are always laid on the older leaves and never on the terminals. Where plants are badly infested the larvæ tie the terminal leaves together in a typical tortricid fashion, thus checking all growth of the plant, and burrow into the flower buds, so that there is no possibility of securing blooms (Plate 16).

The owner of these houses states that some twenty years ago he was troubled with the same insect in rose houses in Massachusetts, but not so seriously and it was gradually brought under control by handpicking. Upon visiting the Waban Rose Conservatories at Natick, Mass., Mr. Alex. Montgomery, the manager, informed the writer that some twenty years ago when hybrid roses were first introduced that they had had considerable trouble with the insect both in the house and on Jacqueminot roses growing out of doors, but that in recent years, though a few were always to be found in old houses, they had found no difficulty in controlling them by handpicking. Mr. Montgomery had just returned from an extensive trip among rose growers thruout the East, but had heard of no noteworthy damage by the insect in recent years, nor do the florists' trade journals give any account of injury, except that Sirrine (1900) mentions it as a carnation pest, where carnations are with or follow roses, implying that it a common rose pest. It is evident, therefore, that serious injury to roses is sporadic as on the apple, and other common food plants.

Food Plants

The list of food plants on record comprises over fifty species, as follows:

Gnaws rinds of apples (Walsh & Riley); currant (Perkins); oak (Hart); cotton (Glover, Mally); rose, apple blossoms and leaves, peach, cherry, yellow birch, plum, clover; honeysuckle, beans, strawberry, *Acer negundo, Crataegus, Cornus stolonifera* (C. H. Fernald); *Betula populifolia* (Packard); ash (Forbes); celery (Davis); pear,—leaves and fruit, gooseberry, black currant, garden geranium, silver maple seeds (Fletcher); plums and prunes (Piper); apple—foliage and young fruit (Lintner); Russian apples defoliated (Lugger); roses (Smith, Davis); blackberry (Chittenden); carnations (Sirrine); basswood (Gibson); bred from apple, cherry, Siberian crab-apple, lilac, horsechestnut, raspberry, wild strawberry, wild rose (*Rosa blanda*), burdock (*Lappa officinalis*), thistle (*Circium lanceolatum*), red clover, ragweed, smartweed, knot grass (*P. aviculare*), and found on burr-oak, poplar, hazel, sumac, wild raspberry, wild blackberry, horse radish, wild sunflower (*Helianthus grosseserratus*) and blue vervain (*Verbena hastata*)—Coquillett; elm, beech (C. H. Fernald, mss.).

Distribution

C. H. Fernald gives the distribution as from Maine to California. Dyar gives Northern United States and Colorado. It undoubtedly occurs thruout the United States as the following records indicate. Maine (Harvey, Packard); Massachusetts (Harris); Ontario (Fletcher et al); New York (Lintner); Pennsylvania, Florida, Texas (Robinson); Kansas (Snow); Nebraska (Bruner); Michigan (Cook); Illinois (Coquillett); Minnesota (Lugger); Washington (Piper); Texas (Mally).

Life History

The larvæ appear in spring and attack the young foliage of the apple as soon as it opens, and later the blossoms and young fruit, as originally described by Harris and by numerous subsequent writers. In the northern states the larvæ mature during June. Coquillet is the only writer who has recorded the length of the pupal stage and gives five to sixteen, average nine days, in Illinois. The moths emerge from May 30 in Delaware, as observed by us, until early July in New England. Dates of emergence of moths as recorded are as follows:—Massachusetts, end of June (Harris); Maine, last of July (Harvey); Vermont, early July (Perkins); New York, July 1 (Fitch), at light June 13 (Lintner); Michigan, mid-June (Cook);

Illinois, late June, early July (Hart, Coquillett). Chittenden secured pupæ and moths from Libonia, Pa., May 3, 1898, but these were from greenhouse roses.

The eggs have been mentioned only by Hart, who states that the eggs overlap in flat masses. Emmons stated that on plum the eggs were laid in patches on the bark in June and July and remain there until the next spring, but as he expresses a doubt as to whether the species was really *rosaceana,* there seems no good reason to give credence to this observation, which probably refers to *A. cerasivorana* which has such habits.[1] A second brood undoubtedly occurs thruout the range of the species. Cook mentions a second brood of larvæ in autumn, observing a larva as late as October 5, and Harvey and Hart mention a second brood of larvæ in August. Coquillett reared moths of a second brood in late July and until mid-August in Illinois, Packard reared a moth September 1 in Maine and Harvey states they occur the last of July. Moffat found moths abundant at London, Ont., in late July and early August, and Snow in Kansas on August 9.

A second brood of moths thus give rise to larvæ which work in the fall. Coquillett hazarded the guess that the eggs passed the winter, but this is the only statement as to the hibernation except that Harvey was candid enough to state that nothing was known of the eggs or hibernation of the species. From the fact that the larvæ occur in fall and early spring and that many species of this family pass the winter as larvæ it seems probable, though we have no definite observations on the point, that the larvæ hibernate over winter probably within folded leaves well encased in their own silk, either attached to the tree or on the ground, altho they may hibernate under or attached to the bark. It seems probable that even in a warm greenhouse the majority of larvæ do not transform in the winter, as Mr. Montgomery of Natick, Mass., states that they have never been troubled with them in winter, but that as soon as the spring sunshine warms up the houses they commence to work. We are now making observations on this point. It will be interesting to determine, as we expect to do, whether more than two generations occur in greenhouses, but our present data does not so indicate.

Observations on the Life History

The following observations on the life history were made during August and early September, 1909. The eggs are laid in round or

[1]Weed. Bulletin 81, N. H. Agr. Exp. Sta., p. 17.

oval, flat, green patches, each containing an average of about 117 eggs, as shown below.

Number of eggs:	10–20.	25–50.	75–100.	100–150.	150–200.	275.	300.	360.
Number of masses:	7.	6.	5.	3.	4.	2.	3.	1.

The table shows plainly the great variance in the number of eggs in one mass, ranging as it does from a very few to over 300. A weighted average of the above gives 117 eggs as the average number laid at one time.

The total number of eggs produced by one pair of moths is an interesting as well as an important feature. For this purpose, single pairs of moths which had just emerged, were isolated and placed in glass cylinders containing fresh rose twigs. As soon as the eggs were noted they were removed and counted. The results were as follows:

Number of eggs laid by individual females: 650, 488, 80, 375, 52, 83, 200, 575, 190, 45, 400, 575.

Averaging the above gives 305 eggs to be the average number laid by one female moth at room temperature having a mean of 70°F. The masses vary considerably in size, four millimeters being a good average width. The eggs are glued together by gelatinous material and often overlap. From our observations in the infested greenhouse and in the insectary they are generally deposited on the older leaves of the plant rather than on the fresh shoots. The egg mass is usually a shade lighter than the green leaf. Oviposition usually takes place at night, although cases have been observed on very cloudy days. Practically all the eggs of a mass hatch at once, leaving the empty shells of the mass whitish in appearance. In case of parasitism the individual eggs are blackened by the pupa of the parasite. The figure in Plate 17 above E is a parasitized egg mass, while the light masses are unparasitized.

The time of incubation varies considerably according to the temperature. A number of freshly deposited egg masses were put in vials and placed in an incubator kept at 80°F. The length of the egg, larval, and pupal stages were all determined with specimens kept in a glassfront incubator kept constantly at 80°F., which is practically the mean temperature of the rose house in summer. Observations were made every morning from which were obtained the following data:

Number days' incubation..................	5	6	7	8	9
Number of egg masses....................	10	12	11	9	4

From the above experiment 6.67 days is found to be the average

length of time required for the incubation of one egg mass at what is probably an average mean temperature for a rose house in late summer. Another lot of egg masses was left in the room where the temperature averaged 70°F. From these we obtained the following results:—

Number days' incubation...............	8	9	10	11	12
Number of egg masses................	1	6	6	6	3

At this temperature a single egg mass requires 10.18 days incubation and so takes 3.51 days longer to hatch at 70° than at 80°F.

The larvæ when first hatched are extremely minute and closely resemble the leaf in color. They crawl about for three or four days, feeding here and there and growing rapidly. At the end of this period the young larva begins to form a protection for itself by pulling two or three leaves together, or more frequently a young larva will fold over a single leaf forming a tube open at either end. The leaves are held together by silken threads. The larva feeds upon the inside of the tube or makes short excursions to adjacent leaves which are pulled down and attached to the original tube, so that as the larva increases in size it also increases the size of the nest. It was frequently observed that when all the leaves of a particular part of a plant had been destroyed the larvæ would go to another part of the plant and start new nests. This, however, seems to be dependent on food supply. The length of the larval stage may be seen from the following:—

Larval period in days...	22–25.	26–29.	30.	31–35.	36–40.	41–46.
Number of larvæ.......	11.	16.	13.	28.	14.	9.

The average length of the larval stage is thus 32.69 days at 80°F. There is no doubt but that food conditions may very materially influence the length of the larval stage which is probably somewhat shorter than the above figures indicate. Before pupation the larva draws the leaves together more firmly than usual so that they practically form a cocoon, to the silk of which the pupa is attached by the hooks of the cremaster. The average length of the pupal stage may be seen from the following:—

Pupal period in days........................	5	6	7	8
Number of pupæ............................	13	23	23	9

This gives 6.41 days as the average of the pupal stage at 80°F. Out of 62 pupæ, 35 were males and 27 females. About 30% of the pupæ failed to transform.

The adults emerge during the night and if not disturbed will remain in the vicinity of the pupal cases throughout the following day. Usually the males may be distinguished from the females not only by their smaller size but also by two round black spots on the thorax (Plate 17, B). Mating occurs shortly after emergence. The length of time between emergence and egg deposition may be seen from the following:—

Days from emergence to oviposition....	1	2	3	4	5	6
Number of females...................	1	2	2	4	1	1

Thus on an average a female oviposits at the end of 3.45 days at the room temperature of 70°F. Egg deposition may not, however, all occur at once, as one moth may deposit several egg masses at different times. The average life of an individual as seen from the following is 14.6 days at 70°F:

Length of life in days..........	11	12	13	14	15	17	20
Number of moths..............	2	6	2	2	2	2	4

Summarizing the life history it is found that at a constant temperature of 80°F. the egg stage is 6.67 days, larva 32.69 days, pupa 6.41 days, and life of moth to oviposition 3 days, giving a total of 48.77 days or seven weeks. The difference in rate of development of the eggs at 70°F. would indicate that the total life cycle at 70° would require over ten weeks. This is about the temperature of a rose house in this latitude in September. After October first the houses have a mean of about 62°, running from 56° at night to 70 to 75° in the day. With this temperature the life cycle would probably require three to four months.

Description

Egg mass. (Plate 17, E.) Round or oval, flat, green patches, generally lighter green than the leaf; laid very close together, frequently overlapping; held together by glutinous material; average number in mass, 117; varying in size from a small dot to one-fourth by one-half inch.

Larva. (Plate 17, F). Generally light green in color, varying in some specimens to a reddish or brownish green; a darker green stripe generally evident along the dorso-mesal line; head round, very dark brown or black mottled with brown; mouthparts lighter brown; anterior portion of clypeus light brown; anteclypeus greenish white; labium green with the exception of the distal portion and a black triangular spot near the base; labial palpi green, first and basal segment black; antennæ of three segments; tip of antennæ dark brown,

base green; cervical shield brown or greenish brown, posterior border black, a very distinct dorsal suture lighter; two black tubercles on either side midway between ventral border of cervical shield and prothoracic legs, each provided with two long setæ; prothoracic spiracle posterior to the dorsal tubercle; thoracic legs black, first segment concolorous with body; prolegs and anal legs green; anal shield concolorous with body; spiracles circled with brown on each abdominal segment; third to sixth abdominal segments bearing prolegs; yellowish tubercles as follows,—abdominal segments one to eight bear sub-dorsal tubercles I and II, with single seta, I mesad of II, III just above spiracle and IV–V just below spiracle, VI, VII and VIII as usual; on segment nine II is nearer the meson than I and lies close to the caudal margin, and III just latero-caudad of II; anal segment bears three large sub-dorsal setæ on the caudal half, and a lateral seta on each side; meso- and meta-thorax with a sub-dorsal tubercle bearing two setæ (I), another further latero-cephalad (II), a tubercle with two setæ (III–V ?) in the usual position of the spiracle, and one just caudad of this bearing a single seta (IV); a tubercle in the same position as VI of the abdominal segments further ventrad and apparently homologous; VII and VIII as usual.

Pupa. (Plate 17, C). Light brown just after pupation, becoming much darker with age; lighter on ventral surface; a mid-dorsal dark line beginning with the thorax running the length of the body; the anterior and posterior margins of abdominal segments I to VII inclusive bear a row of short black spines or teeth on both anterior and posterior margins; yellowish setæ are scattered over the body; a decided blackish cremaster nearly twice as long as broad, about equal to the eighth abdominal segment in length, rounded at tip, bearing two strong hooked spines at the tip and one on either side near the tip.

Moth. (Plate 17, A. B.) See Robinson and Clemens (1860) in bibliography.

Natural Enemies

Parasites. It is evident that this species is most effectively held in check by its natural enemies or with so large a list of food plants, wide distribution, and the number of eggs laid, we should have frequent serious outbreaks. What little evidence we have points to the fact that it is held in check by parasites. Coquillett (1882) states that a species of *Glypha* emerges from the larva about the time it should pupate and spins a cocoon from which the parasite emerges 8 to 12 days later; and that in late August, fully one half of the larvæ

are thus parasitized. On some larvæ he observed Tachina fly eggs, and *Perilitus limidiatus* Cresson was reared from one pupa. Cook found that *Glypta simplicipes* Walsh was a very effective parasite of the larvæ and also reared *Microdus laticinctus* from one. Snow reared an unknown tachinid from a larva. Lugger mentions the Baltimore Oriole as a particularly effective enemy of the larvæ.

The outbreak observed by us furnished a case of the most complete parasitism we have ever seen. When first observed in late July from one third to one half of the eggs were parasitized by a species of *Trichogramma*. Two weeks later it was difficult to find an egg mass in which over 95% of the eggs did not contain the black pupæ of the parasite and in most cases 99 to 100% were affected. So effective were the parasites that the control of the outbreak was undoubtedly due to them much more than to any remedial measures.

Remedial Measures

Spraying with arsenate of lead was at once advised by us in the greenhouse above mentioned. The owner hesitated to apply it, however, as it would spot the foliage so as to prevent the sale of any possible blooms, and requested that we experiment with fumigation.

Fumigation. Experiments were, therefore, made at once with hydrocyanic acid gas. For this purpose we had a large box constructed which fitted just inside a window-frame of the insectary workroom. (Plate 18.) This was fastened tightly to the frame, was covered with sheathing paper, all cracks stopped with putty, and the crack between the window sashes plugged with cotton. Thus the box was fully as tight as the average greenhouse. By raising the window from the outside, potted plants could be placed within to test the effect on them and the box could be quickly ventilated. On the inside, a tightly sliding door was fastened and over the opening to the box a canvas sleeve, which was tapered and constricted by an elastic band at the end. With this arrangement, the plants, insects, and acid could be placed in the box through the window on the outside, everything made tight, and the cyanide then poured in from the inside with no possible escape of gas. Furthermore, at any time by inserting one's arm in the sleeve, the sliding door could be raised, a tube containing insects removed, the door then shut, and the tube taken out and subsequently returned in the same way, with practically no loss of gas, thus enabling one to accurately observe the effect on the insects after different lengths of time by having several tubes of insects and taking them out at intervals. The first experiment was made with cyanide at the rate of one ounce to 1200 cubic feet, a rate

often used against aphides by allowing the gas to remain in the house over night, during which time it usually leaks out. In each case several tubes, each containing several specimens of all stages of the insect were used. Though one or two moths and occasionally a larva were killed after three hours exposure, many were alive the next morning, the gas having been generated about 6 p. m. The strength was then doubled to one ounce cyanide to 600 cubic feet, then doubled again, and finally doubled again to one ounce to 150 cubic feet without killing the majority of the larvæ or moths in an hour's exposure, but seriously injuring the plants at the latter strength. Mr. H. F. Hall, formerly horticulturist of this station, who has had extensive experience in greenhouse fumigation, tried similar experiments in a small greenhouse in Massachusetts with the same results. All further experiment with fumigation was therefore dropped.

Arsenate of Lead. Arsenate of lead was then applied to all the plants in the affected houses at the rate of three pounds to the barrel. Many of the worst infested plants were first cut back. This was applied in a novel, but exceedingly effective and practical manner. The tank in which manure water is mixed and the pipes leading from it to all parts of the houses, were flushed out. The arsenate of lead was then mixed up in the tank, hose was attached at each outlet in the houses and when all was ready a score of men commenced spraying, and in an hour and one half the three acres of plants had been thoroughly sprayed without the use of a pump. The application was repeated about a week later. Inasmuch as the eggs are laid on the old foliage and the young larvæ feed upon it, there can be no doubt of the efficacy of arsenate of lead, but its effect was obscured in this case by the almost total parasitism of the eggs. Nevertheless, it probably aided greatly in killing off larvæ and those which hatched from the few unparasitized eggs, for on November 17 larvæ could still be found in some numbers on individual plants here and there. It is questionable whether spraying with arsenate of lead would be desirable on roses except in cases of serious infestation, owing to the spotting of the foliage, but this might be avoided by dusting with dry arsenate of lead. Paris green, dry and sprayed, with and without lime, has been tried by growers in the past, but there is always danger from burning the foliage.

Handpicking. There seems to be no reason why the pest cannot be entirely controlled in rose houses by reasonable diligence in handpicking. This has been practiced for years in some houses where the insect occurs but has never become numerous enough to cause trouble. From our observations we feel that there can be no doubt that hand-

picking so that the insect is never allowed to become abundant enough to warrant spraying or dusting, is by all means the most practical method of control in rose houses. With the removal of the plants and thorough fumigation of the empty houses the pest may thus be easily controlled.

Trap Lights. When the injury was worst, the moths were flying about the house by hundreds, could be picked up beneath every plant, and could be found beneath the benches in the shade in large numbers, often several within a few inches of each other. The owner having observed their attraction to lights, trap lanterns set in pans of water were placed thruout the houses and very large numbers of moths were caught. These lights have been continued during the fall and by the middle of November, fifteen to twenty moths per night were usually caught in the larger house. There can be no doubt of the efficacy of trap lights for this insect in a greenhouse.

For the control of the insect upon apples and other orchard trees, cane and small fruits, and its numerous other food plants, there would appear to be no reason why a thorough application of arsenate of lead to the young foliage and again in midsummer at the time of the emergence of the second brood, should not control it entirely. The determination of its hibernating habits and measures to destroy it in hibernation might also be of value.

Bibliography

Archips rosaceana Harris.

1841. Harris, T. W., Ins. Inj. Vegetation, I ed., p. 348; III ed. (1862), p. 480, f. 238. *Loxotænia.*

1854. ? Emmons, E., Nat. Hist. N. Y., V, 250, pl. VI, figs. 8–11. *Loxotænia.*

1859. Fitch, A., 3d Rept. Ins. N. Y., Ann. Rept. N. Y. St. Agr. Soc., 346. *Loxotænia.*

1860. Clemens, B., Proc. Acad. Nat. Sci. Phila., 347. *Lozotænia.*

1864. Walker, F., List Lepid. Ins. Brit. Mus., XXX, 984. *Tortrix.*

1865. Clemens, B., Proc. Ent. Soc. Phila., V, 136. *Loxotænia.*

1869. Packard, A. S., Guide to Study of Insects, 335. *Lozotænia.*

1869. Robinson, C. T., Trans. Am. Ent. Soc., II, 262, pl. I, figs. 1–3. *Tortrix.*

1869. Walsh, B. D., and C. V. Riley, Amer. Ent. I, 249. *Loxotænia.*

*1871. LeBaron, W., Prairie Farmer, V, 42.

1871. Reed, E. B., Rept. Fruit Gr. Assn. Ont., f. 1870, 127; also Ann. Rept. Nox. Insects Ont., 62. *Loxotænia.*

1872. Saunders, W., Rept. Ent. Soc. Ontario for 1872, 27. *Lozotænia. Lozotænia.*

1873. Saunders, W., Rept. Ent. Soc. Ontario for 1872, 20. Figs. 10, 11.

1874. Saunders, W., Rept. Ent. Soc. Ontario for 1873, 14. Figs. 8, 9. *Lozotænia.*

1875. Zeller, P. C., Verh. Zoöl.-Bot. Ges. Wien, XXV, 215. *Tortrix.*

1877. Perkins, G. H., 4th Rept. Vt. St. Bd. Agr., 146, 152, 156. *Lozotænia.*

1878. French, G. H., 7th Rept. St. Ent. Ill., 256. *Lozotænia.*
1880. Snow, F. H., 9th Rept. Kas. Hort. Soc. for 1879, 201. *Loxotænia.*
1881. Zimmerman, C. D., *Gardner's Monthly*, XXIII, 238. *Loxotænia.*
1882. Coquillett, D. W., 11th Rept. St. Ent. Ill., 10. *Loxotænia.*
1882. Fernald, C. H., Trans. Am. Ent. Soc., X, 10. *Cacœcia.*
1882. Packard, A. S., Papilio, II, 182. *Cacœcia.*
1883. Coquillett, D. W., Papilio, III, 100. *Lozotænia.*
1883. Saunders, W., Ins. Inj. Fruits, 91, figs. 89–91. *Cacœcia.*
1884. Forbes, S. A., Trans. Ill. St. Hort. Soc., 121. *Cacœcia rosacæ;* also Trans. Miss. Vall. Hort. Society.
1884. Forbes, S. A., 13th Rept. St. Ent. Ill., 94. *Cacœcia.*
1888. Perkins, G. H., 2d Rept. Vt. Agr. Exp. Sta., 133.
1889. Brackett, G. C., Kas. Hort. Soc. Rept. XVII, 267. *Loxotænia.*
1891. Cook, A. J., 4th Rept. Mich. Agr. Exp. Sta., in Rept. Mich. Bd. Agr., f. 1891, 139, fig. 13. *Cacœcia.*
1893. Moffat, J. A., Rept. Ent. Soc. Ont. for 1892, 45, fig. 20. *Cacœcia.*
1894. Bruner, L., Ann. Rept. Nebr. Hort. Soc., XXV, 158, 203, fig. 63.
1894. Davis, G. C., Bull. 102 Mich. Agr. Exp. Sta., 31. *Cacœcia;* also Rept. Mich. Bd. Agr. for 1894, 168.
1895. Fletcher, J., Rept. Exptl. Farms, Canada, for 1894, 197. *Cacœcia.*
1895. Fletcher, J., Rept. Ent. Soc. Ont. for 1894, 80, figs. 53–55. *Cacœcia.*
1895. Harvey, F. L., Rept. Me. Agr. Exp. Sta., 110, figs. 7, 8. *Cacœcia.*
1895. Piper, C. V., Bull. 17 Wash. Agr. Exp. Sta., 16, figs 8–10. *Cacœcia.*
1896. Lintner, J. A., Bull. 6, n. s. Div. Ent., U. S. Dept. Agr., 57. *Cacœcia.*
1896. Lugger, O., Bull. 43, Minn. Agr. Exp. Sta., 196. *Cacœcia.*
1896. Smith, J. B., Econ. Entomology, 321, fig. 370. *Cacœcia.*
1897. Davis, G. C., Spec. Bull. 2 Mich. Agr. Exp. Sta., 40, fig. 31. *Cacœcia.*
1898. Lintner, J. A., 12th Rept. Inj. Ins. N. Y. for 1896, 312. *Cacœcia.*
1899. Lugger, O., 4th Rept. St. Ent. Minn., 226. *Cacœcia.*
1899. Wood, E. M., Am. Florist, Sept. 23, 223.
1900. Bruner, L., Rept. Nebr. Hort. Soc., XXXI, 59, 90, fig. 30. *Cacœcia.*
1900. Chittenden, F. H., Bull. 22, n. s., Div. Ent. U. S. Dept. Agr., 57. *Cacœcia.*
1900. Fletcher, J., Bull. 26, n. s., Div. Ent. U. S. Dept. Agr., 94. *Cacœcia.*
1900. Harvey, F. L., 15th Rept. Me. Agr. Exp. Sta., 116. *Cacœcia rosana.* 16th Rept. Me. Agr. Exp. Sta. 32.
1900. Sanderson, E. D., Bull. 26, n. s., Div. Ent. U. S. Dept. Agr., 68. *Cacœcia.*
1900. Sirrine, F. A., Weekly Florist's Review, 343. *Cacœcia.* Also The American Florist, Mar. 3.
1901. Chittenden, F. H. Bull. 27, Div. Ent. U. S. Dept. Agr., 87. *Cacœcia.*
1901. Sanderson, E. D., 12th Rept. Del. Agr. Exp. Sta., 200. *Cacœcia.*
*1901. Stedman, J. M., Colman's Rural World, July 3, 209.
1902. Dyar, H. G., List N. Am. Lepid., 478. *Archips.*
1902. Mally, F. W., Report on Boll Worm, 33. *Cacœcia.*
1903. Chittenden, F. H., Yearbook U. S. Dept. Agr., for 1902, 730. *Archips.*
1903. Hart, C. A., Ill. St. Lab. Nat. Hist., Synop. Coll. Lepid., 62, fig. 71. *Archips.*

*With the exception of the two references *, all have been verified by the writer. We are indebted to Dr. H. T. Fernald for a copy of the bibliography of his office.

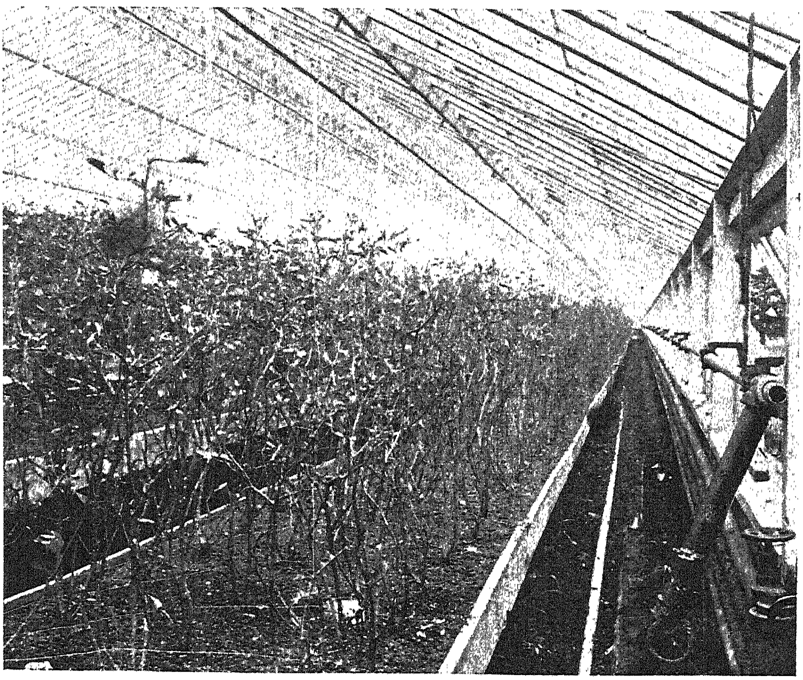


PLATE 15.—Injury in rose house by the Oblique-banded Leaf-roller. The upper view shows the complete defoliation of the plants on the benches seen in the lower view. Photos by W. S. Abbott.

PLATE 16.—Showing injury to terminals and buds of rose by the Oblique-banded Leaf-roller. Photos by W. S. Abbott.

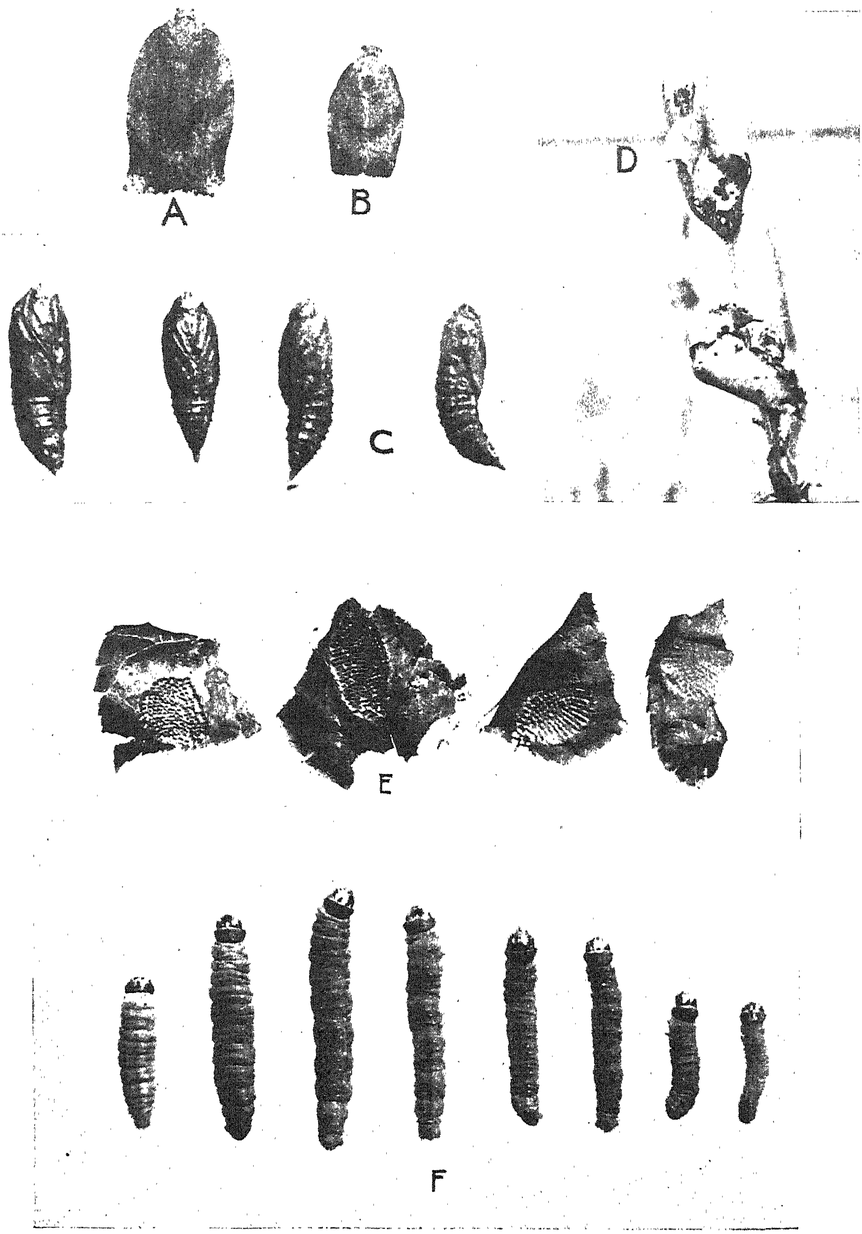


PLATE 17.—A, female moth; B, male moth; C, pupæ; D, moth at rest on foliage, natural size from life; E, egg masses, the one immediately above E full parasitized, the next partially and the one at right unparasitized; F, larvæ—all greatly enlarged. Photos by W. S. Abbott.

1903. Holland, W. J., Moth Book, 422, pl. XLVIII, fig. 32. *Archips.*
1904. Gibson, A., 34th Rept. Ent. Soc. Ont., 57, fig. *Archips.*
1904. Washburn, F. L., 9th Rept. St. Ent. Minn., 54, fig. 39. *Cacœcia.*
1905. Currie, R. P., Bull. 53, Bur. Ent., U. S. Dept. Agr., 15, 34. *Archips.*
1905. Kellogg, V. L., American Insects, 380. *Cacœcia.*
1906. Felt, E. P., Ins. Aff. Park and Woodland Trees, II, 512, 580–81. *Archips.*

vicariana Walker.

1863. Walker, F., List Lepid. Ins. Brit. Mus., XXVIII, 287. *Teras.*
1882. Fernald, C. H., Trans. Am. Ent. Soc., X, 10.=*C. rosaceana* Harr.

gossypiana Packard.

1869. Packard, A. S., Guide to Study of Insects, 335. *Lozotœnia.*
1855. Glover, T., Agr. Rept. U. S. Patent Office, 82, pl. VI, fig. 10. *Tortrix?*
1882. Fernald, C. H., Trans. Am. Ent. Soc., X, 10.=*C. rosaceana.*

articana Moeschler.

1874. Moeschler, H. B., Stett. Ent. Zeit., XXXV, 164. *Tortrix.*
1882. Fernald, C. H., Trans. Am. Ent. Soc., X, 10.=*C. rosaceana.*

THE GEOGRAPHICAL DISTRIBUTION OF AMERICAN TICKS

By W. A. Hooker, *Washington, D. C.*

In the fourth part of the last memoir of his revision of the ticks, published in 1901, Prof. L. G. Neumann considers their geographical distribution, the species being brought together under the various political divisions of the world in which they are known to occur. The North American species listed are largely based upon the Marx collection of the United States National Museum and the collection of the Bureau of Animal Industry of the United States Department of Agriculture.

Since this account was published there has been an increased activity in the collection of ticks in this country which has resulted in the discovery of many new forms and of a wider distribution of the species recorded than was then known. In Neumann's "Notes sur les Ixodidés," which have followed the "Memoirs," new records have been given which include data on American species. With the appearance of Banks' Revision of the ticks of this country, several new species were described and a number of names were relegated to synonyms through the recognition of Say's and Packard's species. In preparing his "Revision," Mr. Banks examined the collection of the Museum of Comparative Zoölogy, which contains Packard's types,

and had at hand several state collections, as well as the national collections.

In the study of the geographical distribution of the species the writer has attempted to bring these records together. In doing this he has examined the national collections and through the courtesy of Mr. Nathan Banks has also examined his personal collection and been permitted to use the distribution records of the species in the collections which Mr. Banks examined. Most of the records of the species from the different collections are based upon Mr. Banks' determinations. In the following list references are given to Neumann's records, so far as possible to the collections which contain specimens, and occasionally to other records. A list of the abbreviations used will be found appended.

The records of exotic species are largely based upon Neumann's determinations and upon the national collections. References are given to Dr. F. Lahille's records in his work on the ticks of Argentina. Dr. H. B. Aragao, who has studied the Brazilian ticks and described a number of new species, has kindly furnished the writer with a list of the species known to him to occur in that country. The writer wishes to express his gratitude to these workers for the literature and other favors received.

Distribution of American Ticks

North America—No locality given.

Amblyomma multipunctum (N. 1901).
Ixodes brunneus (N. 1901).

Alaska.

Ceratixodes putus (B. E. Coll.).
Dermacentor variabilis (N. 1901).
Ixodes angustus (Bks. Coll.).

Aleutian Islands.

Ceratixodes putus (=*hirsutus*) (N. 1901; Bks. Rev.).
Ceratixodes signatus (Bks. Rev.).

Pribilof Islands.

Ixodes arcticus (Bks. Rev.; Nat. Mus. Coll.? [Type]).

St. Paul Island (Alaska).

Ceratixodes putus (N. 1901 and 1904; Bks. Rev.).

Bering Island (near Aleutian Islands).

Ceratixodes (*Ixodes*) *putus* (=*fimbriatus*) (N. 1901; B. E. Coll.).
Ceratixodes signatus (B. E. Coll.).

ST. PIERRE and MIQUELON ISLANDS (near Newfoundland).

Ceratixodes putus (N. 1901 and 1902).

BAFFIN LAND.

Ceratixodes putus (=*uriæ*) (N. 1901).

LABRADOR.

Amblyomma americanum (N. 1901; Marx Coll.).
Dermacentor variabilis (N. 1901; Bks. Rev.).

NOVA SCOTIA.

Dermacentor albipictus (Pack. Amer. Nat. 1868, p. 559; Pack. Ann. Rep. 1869; Pack. Guide, p. 662).

BRITISH COLUMBIA.

Ceratixodes putus (N. 1904).
Dermacentor albipictus (Bks. Rev.).
Dermacentor venustus (B. E. Coll.).
Ixodes angustus (Bks. Coll.).

ONTARIO.

Ixodes cookei (Bks. Coll.).
Ixodes marxi (Bks. Coll.).

MAINE.

Ixodes cookei (=*hexagonus longispinosus*) (N. 1901; M. C. Z. Coll.; Marx Coll.).

NEW HAMPSHIRE.

Dermacentor albipictus (=*variegatus*) (S. & S. 1901).

VERMONT.

Dermacentor variabilis (B. E. Coll.).
Hæmaphysalis chordeilis (B. E. Coll.; Hadley 1909).

MASSACHUSETTS.

Amblyomma americanum (=*I. unipunctata*) (Pack. Ann. Rep. 1869; Pack. Amer. Nat. 1869, p. 370; Pack. Guide, p. 662).
Dermacentor albipictus (M. C. Z. Coll.) Type.
Dermacentor variabilis (N. 1901; Bks. Coll.; N. Y. S. M. Coll.; M. C. Z. Coll.; Cornell Coll.; Bks. Coll.; Marx Coll.).
Hæmaphysalis chordeilis (Pack. Ann. Rep. 1869; Bks. Rev.) Type locality.
Hæmaphysalis leporis-palustris (N. 1901).
Ixodes brunneus (Mass. A. C. Coll.).
Ixodes cookei (=*H. concinna*) (N. 1901; M. C. Z. Coll. [Type]; Mass. A. C. Coll.).

RHODE ISLAND.

None recorded.

CONNECTICUT.

None recorded.

NEW YORK.

Amblyomma americanum (Bks. Rev.).
Dermacentor nigrolineatus (=*H. concinna*) (N. 1901; M. C. Z. Coll. [Type]; N. Y. S. M. Coll.; Bks. Coll.)
Dermacentor albipictus (=*D. variegatus*) (S. & S. 1901; Bks. Rev.).
Dermacentor variabilis (Stiles Coll.; Cornell Coll.; Bks. Coll.; B. E. Coll.).
Hœmaphysalis chordeilis (B. E. Coll.).
Hœmaphysalis leporis-palustris (N. Y. S. M. Coll.).
Ixodes cookei (=*hexagonus longispinosus*) (N. 1901; N. Y. S. M. Coll.; Cornell Coll.; M. C. Z. Coll.; Marx Coll.; B. E. Coll.).
Ixodes marxi (Cornell Coll.; Bks. Coll.).

NEW JERSEY.

Amblyomma americanum (Leidy 1890, p. 278; Bks. Rev.).
Ixodes cookei (B. E. Coll.; Bks. Rev.).

PENNSYLVANIA.

Amblyomma americanum (=*I. unipunctata*) (Pack. Ann. Rep. 1869; Pack. Amer. Nat. 1869, p. 370; Pack. Guide, p. 662; Bks. Rev.).
Dermacentor variabilis (N. 1901).
Ixodes scapularis or *cookei* (=*ricinus*) (N. 1901).

DELAWARE.

None recorded.

MARYLAND.

Dermacentor variabilis (N. 1901; Stiles Coll.; B. E. Coll.).
Ixodes brunneus (=*frontalis*) (N. 1901; Bks. Rev.).
Ixodes cookei (Bks. Rev.).
Ixodes dentatus (Marx. Coll.) Type.
Ixodes hexagonus (N. 1901; Bks. Rev.).
Ixodes scapularis (Bks. Rev.).

DISTRICT OF COLUMBIA.

Amblyomma americanum (Marx. Coll.; Bks. Coll.).
Dermacentor albipictus (Packard Ann. Rep. 1869).
Dermacentor variabilis (Bks. Coll.; B. E. Coll.).

Ixodes cookei (Marx Coll.).
Ixodes marxi (Marx Coll.).
Margaropus annulatus (N. 1901; Marx. Coll.) Accidental.

VIRGINIA.

Amblyomma americnum (=*A. unipunctata*) (Niles 1900; Bks. Coll.; B. E. Coll.).
Amblyomma maculatum (Niles 1900; H. & H. Bull.; Bks. Rev.).
Dermacentor variabilis (=*Ixodes 5-striatus*) (Fitch 1872; Bks. Coll.).
Hæmaphysalis leporis-palustris (Marx. Coll.).
Ixodes dentatus (Bks. Coll.).
Ixodes scapularis (=*I. ricinus*) (Bks. Coll.; Niles 1900).
Margaropus annulatus (B. A. I. Quar. Area).

CAROLINA. (Not designated.)

Amblyomma maculatum (N. 1901; Bks. Rev.).
Ixodes scapularis (=*ricinus*) (N. 1901).

NORTH CAROLINA.

Amblyomma americanum (Cornell Coll.).
Dermacentor variabilis (B. E. Coll.).
Hæmaphysalis leporis-palustris (Bks. Rev.) Type locality.
Ixodes brunneus (Bks. Coll.).
Ixodes scapularis (Bks. Rev.).
Margaropus annulatus (B. A. I. Quar. Area).

SOUTH CAROLINA.

Ixodes scapularis (M. C. Z. Coll.).
Margaropus annulatus (B. A. I. Quar. Area).

GEORGIA.

Margaropus annulatus (B. A. I. Quar. Area).

FLORIDA.

Amblyomma americanum (N. 1901; Marx Coll.; B. E. Coll.).
Amblyomma cajennense (Marx Coll.).
Amblyomma maculatum (B. E. Coll.).
Amblyomma tuberculatum (N. 1901; Marx Coll. [Type]; Bks. Coll.; B. E. Coll.).
Aponomma inornata (Hook. Notes).
Argas miniatus (S. & S. 1901).
Dermacentor variabilis (Cornell Coll.; B. E. Coll.).
Hæmaphysalis leporis-palustris (B. E. Coll.).
Ixodes scapularis (=*ricinus*) (N. 1901; B. E. Coll.; Bks. Coll.).

Margaropus annulatus (Say 1821; N. 1901; B. A. I. Quar. Area) Type locality.
Ornithodoros talaje (Marx Coll.).
Ornithodoros turicata (=*O. americanus*) (Hubbard 1894; N. 1901; Marx Coll.).

MICHIGAN.

Amblyomma americanum (Mich. A. C. Coll.).
Dermacentor albipictus (Bks. Coll.).
Dermacentor variabilis (Mich. A. C. Coll.).
Ixodes cookei (Mich. A. C. Coll.).
Ixodes marxi (Bks. Coll.).
Margaropus annulatus (Mich. A. C. Coll.) Accidental.

OHIO.

Dermacentor variabilis (Stiles Coll.; Osb. Coll.; Bks. Coll.).
Ixodes marxi (Osb. Coll.; Bks. Coll.).

INDIANA.

Ixodes scapularis (Bks. Coll.).

ILLINOIS.

Margaropus annulatus (N. 1901; Garman Coll.). Accidental.

WEST VIRGINIA.

Dermacentor variabilis (B. E. Coll.).

KENTUCKY.

Amblyomma americanum (Bks. Coll.; Garman Coll.; M. C. Z. Coll.).
Dermacentor variabilis (M. C. Z. Coll.).
Margaropus annulatus (N. 1901; B. A. I. Quar. Area).
Ornithodoros megnini (Garman Coll.; Bks. Coll.).

TENNESSEE.

Amblyomma maculatum (N. 1901; Marx Coll.) Accidental?
Dermacentor variabilis (B. E. Coll.).
Margaropus annulatus (B. A. I. Quar. Area).

ALABAMA.

Amblyomma tuberculatum (Hook. Notes).
Dermacentor variabilis (N. 1901).
Hæmaphysalis leporis-palustris (B. E. Coll.).
Margaropus annulatus (B. A. I. Quar. Area).

MISSISSIPPI.

Margaropus annulatus (B. A. I. Quar. Area).

MINNESOTA.

Dermacentor variabilis (N. 1901).
Hæmaphysalis leporis-palustris (Washb. Coll.).
Ixodes cookei (Washb. Coll.).

WISCONSIN.

Dermacentor nigrolineatus (Bks. Rev.).

IOWA.

Argas miniatus (Marx Coll.).
Dermacentor variabilis (B. E. Coll.).
Ixodes angustus (B. A. I. Coll.; Bks. Rev.).
Ixodes cookei (=*Ixodes hexagonus*) (N. 1901; Marx Coll.).
Ixodes scapularis (M. C. Z. Coll.).
Ornithodoros megnini (M. C. Z. Coll.; Marx Coll.).

MISSOURI.

Amblyomma americanum (M. C. Z. Coll.; B. E. Coll.; Bks. Coll.).
Ixodes scapularis (B. E. Coll.).
Margaropus annulatus (B. A. I. Quar. Area).

ARKANSAS.

Amblyomma americanum (B. E. Coll.).
Dermacentor variabilis (=*Ixodes 5-striatus*) (Fitch 1872).
Margaropus annulatus (N. 1901; B. E. Coll.; B. A. I. Quar. Area).

LOUISIANA.

Amblyomma americanum (Morgan 1899; B. E. Coll.).
Amblyomma maculatum (B. E. Coll.; Newell Coll.).
Dermacentor variabilis (Morgan 1899; B. E. Coll.).
Hæmaphysalis leporis-palustris (Bks. Coll.; B. E. Coll.).
Ixodes cookei (=*I. ricinus* on mink) (Morgan 1899).
Ixodes scapularis (=*I. ricinus* on cattle) (Morgan 1899; B. E. Coll.).
Margaropus annulatus (Morgan 1899; B. E. Coll.; B. A. I. Quar. Area).
Ornithodoros megnini (Bks. Coll.; B. E. Coll.).

NORTH DAKOTA.

Dermacentor variabilis (B. E. Coll.).

SOUTH DAKOTA.

Ixodes cookei (Bks. Coll.).

NEBRASKA.

Dermacentor albipictus (=*D. variegatus*) (S. & S. 1901; N. 1901; Bks. Rev.).

Ornithodoros megnini (S. & S. 1901).

KANSAS.

Dermacentor variabilis (N. 1901).

Hœmaphysalis leporis-palustris (N. 1901).

Ixodes cookei (N. 1901; Marx Coll.; Bks. Coll.).

Ixodes hexagonus (Bks. Rev.).

Ixodes ricinus (N. 1901; Bks. Rev.).

Margaropus annulatus (N. 1901; Marx Coll.).

Ornithodoros megnini (S. & S. 1901).

OKLAHOMA.

Amblyomma americanum (B. E. Coll.).

Dermacentor variabilis (=*Ixodes robertsonii*) (Fitch 1872).

Hœmaphysalis leporis-palustris (B. E. Coll.).

Margaropus annulatus (B. A. I. Quar. Area).

Ornithodoros megnini (Lewis 1908).

TEXAS.

Amblyomma americanum (N. 1901; M. C. Z. Coll.; Cornell Coll.; B. E. Coll.).

Amblyomma cajennense (Marx Coll.; B. E. Coll.).

Amblyomma dissimile (B. E. Coll.) Accidental.

Amblyomma maculatum (N. 1901; B. E. Coll.; Marx Coll.).

Aponomma inornata (B. E. Coll.) Type.

Argas miniatus (N. 1901; B. E. Coll.; Marx Coll.)

Dermacentor bifurcatus (Bks. Rev.) Probably a nymph of some other species.

Dermacentor marginatus (B. E. Coll.).

Dermacentor nigrolineatus (B. E. Coll.).

Dermacentor nitens (B. E. Coll.).

Dermacentor venustus (Bks. Rev.).

Dermacentor occidentalis? (=*reticulatus*) (N. 1901; S. & S. 1901).

Dermacentor variabilis (N. 1901; B. E. Coll.; Bks. Coll.).

Hœmaphysalis chordeilis (B. E. Coll.).

Hœmaphysalis leporis-palustris (N. 1901; Bks. Coll.; B. E. Coll.; Marx Coll.).

Ixodes brunneus (N. 1901).

Ixodes cookei (=*hexagonus longispinosus*) (N. 1901; B. E. Coll.; Marx Coll.).

Ixodes pratti (B. E. Coll.) Type.
Ixodes ricinus (N. 1901; Marx Coll.; B. E. Coll.).
Ixodes scapularis (B. E. Coll.; M. C. Z. Coll.; Bks. Coll.).
Ixodes sculptus (B. E. Coll.).
Ixodes texanus (B. E. Coll.) Type.
Margaropus annulatus (N. 1901; Marx Coll.; B. E. Coll.; B. A. I. Quar. Area).
Ornithodoros megnini (M. C. Z. Coll.; Bks. Coll.; B. E. Coll.).
Ornithodoros talaje (Bks. Coll.; B. E. Coll.).
Ornithodoros turicata (N. 1901; B. E. Coll.; Bks. Coll.).
Rhipicephalus texanus (M. C. Z. Coll.; B. E. Coll. [Type]).

MONTANA.

Dermacentor albipictus (Bks. Rev.).
Dermacentor variabilis ? (N. 1901).
Dermacentor venustus (Bks. Coll.; Stiles Coll.; B. E. Coll.).

WYOMING.

Dermacentor venustus (B. E. Coll.).

COLORADO.

Dermacentor variabilis (N. 1901).
Dermacentor venustus (Bks. Coll.).
Hæmaphysalis leporis-palustris (Marx Coll.).
Ixodes cookei (Marx Coll.).
Ixodes marxi (Marx Coll.).

NEW MEXICO.

Argas miniatus (B. E. Coll.).
Dermacentor occidentalis? (=*reticulatus*) (N. 1901; S. & S. 1901).
Dermacentor variabilis (N. 1901).
Dermacentor venustus (Bks. Coll.).
Ixodes diversifossus (N. 1901; Hass. Coll. [Type]; Bks. Rev.).
Margaropus annulatus (N. 1901; Marx Coll.).
Ornithodoros megnini (Bks. Coll.; B. E. Coll.; Stiles Coll.).
Ornithodoros turicata (Marx Coll.).
Rhipicephalus texanus (B. E. Coll.; Bks. Coll.).

IDAHO.

Dermacentor albipictus (=*variegatus*) (Bks. Coll.).
Dermacentor modestus (B. E. Coll.) Type.
Dermacentor venustus (B. E. Coll.).
Ixodes angustus (N. 1899; B. A. I. Coll. [Type]).
Ornithodoros megnini (Bks. Rev.).

UTAH.

Dermacentor venustus (M. C. Z. Coll.).

NEVADA.

Dermacentor albipictus (=*variegatus*) (N. 1901; S. & S. 1901; Bks. Rev.).
Dermacentor venustus (Stiles Coll.).
Hæmaphysalis leporis-palustris (B. E. Coll.).
Ornithodoros megnini (Marx Coll.; B. E. Coll.).

ARIZONA.

Amblyomma cajennense? (Bks. Coll.).
Argas brevipes (B. E. Coll.) Type.
Argas miniatus (B. E. Coll.).
Dermacentor marginatus (Bks. Coll.) Type.
Dermacentor nitens? (Bks. Coll.).
Dermacentor occidentalis (Osb. Coll.).
Dermacentor parumapertus (Bks. Coll.).
Dermacentor variabilis (N. 1901).
Hæmaphysalis leporis-palustris (Bks. Coll.).
Margaropus annulatus (Bks. Coll.).
Ornithodoros megnini (Marx Coll.; B. E. Coll.).
Ornithodoros turicata (Marx Coll.).

WASHINGTON.

Dermacentor albipictus (=*variegatus*) (N. 1901; S. & S. 1901; Bks. Coll.).
Dermacentor modestus (B. E. Coll.) Type.
Dermacentor venustus (M. C. Z. Coll.; B. E. Coll.; Bks. Coll.).
Ixodes cookei (Bks. Coll.).

OREGON.

Ixodes angustus (B. E. Coll.).

CALIFORNIA.

Amblyomma cajennense (Bks. Rev.).
Amblyomma maculatum (N. 1901; Marx Coll.).
Argas miniatus (N. 1901; Marx Coll.; Bks. Coll.; B. E. Coll.).
Ceratixodes signatus (B. E. Coll.).
Dermacentor occidentalis (=*reticulatus*) (N. 1901; M. C. Z. Coll.; Hass. Coll.; Marx Coll. [Cotype]; B. E. Coll.; Bks. Coll.).
Dermacentor parumapertus (N. 1901; Bks. Coll.; Marx Coll. [Cotype]).

Dermacentor variabilis (N. 1901).
Hæmaphysalis leporis-palustris (N. 1901; B. E. Coll.; Bks. Coll.).
Ixodes æqualis (W. and W. 1909; Bks. Coll. [Type]). Banks' manuscript name.
Ixodes angustus (Bks. Coll.).
Ixodes brunneus (=*kelloggi*) (Bks. Rev.).
Ixodes californicus (Marx Coll.; B. E. Coll.; Bks. Coll. [Type]).
Ixodes pratti (B. E. Coll.; Bks. Rev.).
Ixodes sculptus (Neum. 1904; Marx Coll. [Type]).
Margaropus annulatus (B. E. Coll.; B. A. I. Quar. Area).
Ornithodoros coriaceus (B. E. Coll.; Bks. Coll.).
Ornithodoros megnini (Marx Coll.; B. E. Coll.; Bks. Coll.).
Ornithodoros talaje (Bks. Coll.).
Ornithodoros turicata (M. C. Z. Coll.; Marx Coll.).

HAWAII.

Amblyomma pacificum (N. 1901).
Ornithodoros talaje (N. 1901).
Rhipicephalus sanguineus (B. E. Coll.).

PHILIPPINE ISLANDS.

Amblyomma cyprinum (N. 1901).
Amblyomma decoratum (N. 1901).
Amblyomma dissimile (N. 1901; Marx Coll.).
Amblyomma helvolum (N. 1901).
Aponomma gervaisi (B. E. Coll.).
Margaropus annulatus australis (C. S. Bks. 1904).
Rhipicephalus sanguineus (N. 1901).

MEXICO.

Amblyomma cajennense (N. 1901; Marx Coll.).
Amblyomma coelebs (N. 1901 and 1906).
Amblyomma dissimile (N. 1901; B. E. Coll.).
Amblyomma maculatum (N. 1901).
Amblyomma ovale (N. 1901).
Argas miniatus (N. 1901).
Dermacentor variabilis (N. 1901).
Hæmaphysalis leporis-palustris (N. 1901).
Hyalomma syriacum (N. 1901). Probably accidental.
Ixodes ameivæ (N. 1901).
Ixodes diversifossus (=*bicornis*) (N. 1906; Bks. Rev.).
Ixodes rubidus (N. 1901).
Margaropus annulatus (N. 1901).

Ornithodoros coriaceus (N. 1901; Bks. Rev.).
Ornithodoros megnini (N. 1901; B. E. Coll.; M. C. Z. Coll.).
Ornithodoros talaje (N. 1901).
Ornithodoros turicata (Bks. Rev.).
Rhipicephalus texanus (M. C. Z. Coll.; B. E. Coll.).

GUATEMALA.

Amblyomma americanum (N. 1901).
Amblyomma cnjennense (N. 1901; B. E. Coll.). Common.
Amblyomma dissimile (N. 1901).
Amblyomma sabaneræ (N. 1901).
Amblyomma scutatum (N. 1901).
Amblyomma variegatun (H. 1901).
Amblyomma varium (B. E. Coll.).
Dermacentor nitens (N. 1901).
Ixodes minor (N. 1902).
Margaropus annulatus australis (N. 1901).
Ornithodoros talaje (N. 1901).

HONDURAS.

Amblyomma cajennense (Marx Coll.).
Amblyomma dissimile (N. 1901).
Amblyomma humerale? (B. E. Coll.).
Hyalomma cycluræ (N. 1901).
Margaropus annulatus (N. 1901; Marx Coll.).
Ornithodoros turicata (B. E. Coll.).

SALVADOR.

None recorded.

NICARAGUA.

Amblyomma cajennense (N. 1901; M. C. Z. Coll.).
Amblyomma crassipunctum (N. 1901).
Amblyomma dissimile (N. 1901; Marx Coll.).
Ixodes (?) *bibroni* (Pack. Ann. Rep. 1869).
Margaropus annulatus (=*Ixodes bovis*) (Pack Ann. Rep. 1869).

COSTA RICA.

Amblyomma cajennense (N. 1901).
Amblyomma fossum (N. 1901).
Amblyomma nodosum (N. 1901).
Dermacentor nitens (B. E. Coll.; Newell Coll.).
Ixodes scapularis (=*affinis*) (N. 1901; Bks. Rev.).
Margaropus annulatus australis (B. E. Coll.; Newell Coll.).

PANAMA.

Amblyomma cajennense (Marx Coll.; B. E. Coll.).
Margaropus annulatus australis (B. E. Coll.).
Rhipicephalus texanus (B. E. Coll.).

BERMUDAS.

Amblyomma cajennense (C. H. T. T. No. 69).

BAHAMAS.

An undetermined larva from a bat (*Phillonycteris sp.*) (B. E. Coll.).

CUBA.

Amblyomma albopictum (N. 1901; B. E. Coll.).
Amblyomma cajennense (N. 1901).
Amblyomma tuberculatum (N. 1901).
Amblyomma or *Hyalomma* sp. (B. E. Coll.). Larvæ only.
Argas miniatus (B. E. Coll.).
Dermacentor nitens (Mayo 1906).
Margaropus annulatus (N. 1901; Marx Coll.; B. E. Coll.; Mayo 1906).
Margaropus annulatus australis (Mayo 1906).
Ornithodoros marginatus (B. E. Coll. [Type]). Bks. Mss. name.
Rhipicephalus bursa (N. 1897).

JAMAICA.

Amblyomma cajennense (N. 1901; Marx Coll.).
Amblyomma maculatum (Marx Coll.).
Argas miniatus (Jo. Inst. Jam. 1897).
Dermacentor nitens (N. 1901; Marx Coll. [Cotype]).
Margaropus annulatus australis (N. 1901; B. E. Coll.).
Ornithodoros turicata (=*O. americanus*) (C. H. T. T. No. 71, Jo. Inst. Jam., vol I).
Rhipicephalus bursa americanus (N. 1901).

HAITI.

Amblyomma cruciferum (N. 1901).
Dermacentor nitens (N. 1901; M. C. Z. Coll.).
Rhipicephalus bursa (N. 1901).
Rhipicephalus texanus (M. C. Z. Coll.).

SAN DOMINGO.

Dermacentor nitens (N. 1897).

PORTO RICO.

Amblyomma cruciferum (B. E.Coll.). On Mona Island.
Aponomma gervaisi? (B. E. Coll.). Isabel Island (Porto Rico? or Galapagos Island?).
Margaropus annulatus australis (B. E. Coll.).

ST. CHRISTOPHER (ST. KITTS).

Amblyomma variegatum (B. E. Coll.).

ANTIGUA.

Amblyomma dissimile (C. H. T. T. No. 69; Jo. Inst. Jam. I, 1893).
Amblyomma variegatum (N. 1901).
Argas miniatus (N. 1901).
Margaropus annulatus australis (N. 1901).
Rhipicephalus sanguineus (N. 1901).

GUADELOUPE.

Amblyomma hirtum (N. 1906).
Amblyomma variegatum (N. 1901).
Hyalomma ægyptium (N. 1901).
Margaropus annulatus australis (N. 1901).

DOMINICA.

Margaropus annulatus australis (B. E. Coll.).
Rhipicephalus sanguineus (N. 1901).

MARTINIQUE.

Argas miniatus (Sim. Aub. and Noc. 1909).

BARBADOS.

Amblyomma dissimile (N. 1901; Marx Coll.).

TRINIDAD.

Amblyomma dissimile (N. 1902).
Argas miniatus (B. E. Coll.).
Dermacentor nitens (B. E. Coll.).
Hyalomma longirostre (N. 1901).
Margaropus annulatus australis (B. E. Coll.).
Rhipicephalus sp. (C. H. T. T. No. 69).

CURACAO ISLAND (Near VENEZUELA).

Rhipicephalus bursa (N. 1901).

TRINITE?

Amblyomma cajennense (N. 1901).

SOUTH AMERICA.

Amblyomma strobeli (N. 1901).
Ixodes (?) *bibroni* (N. 1901).
Ixodes fuscomaculatus (N. 1901).
Ixodes perpunctatus (N. 1901).

COLOMBIA.

Amblyomma cajennense (N. 1901).
Amblyomma diminutivum (N. 1901).
Amblyomma dissimile (N. 1901).
Amblyomma geayi (N. 1901).
Amblyomma striatum (N. 1901).
Argas chinche (N. 1901).
Ixodes juvensis (N. 1901).
Ornithodoros rudis (N. 1901).
Ornithodoros talaje (N. 1901).
Rhipicephalus sanguineus (N. 1901).

VENEZUELA.

Amblyomma cajennense (N. 1901; B. E. Coll.).
Amblyomma dissimile (N. 1901).
Amblyomma bispinosum (N. 1906).
Hyalomma longirostre (N. 1901).
Ornithodoros talaje (N. 1901).
Ornithodoros turicata (Marx Coll.).

GUIANA. (Not designated.)

Amblyomma americanum (N. 1901).
Amblyomma cajennense (N. 1901).
Amblyomma dissimile (N. 1901).
Amblyomma goldii (N. 1901).
Amblyomma grossum (N. 1901).
Amblyomma oblongoguttatum (N. 1901).
Margaropus annulatus australis (N. 1901).
Rhipicephalus sanguineus (N. 1901 and 1902).

BRITISH GUIANA.

Argas miniatus (N. 1901). Demerara.
Margaropus annulatus australis (C. H. T. T. No. 69).

DUTCH GUIANA.

None recorded.

FRENCH GUIANA.

Amblyomma cajennense (N. 1899).

ECUADOR.

Amblyomma incisum (N. 1906).
Amblyomma maculatum (N. 1901).
Amblyomma pilosum (N. 1901).
Argas magnus (N. 1901).
Ixodes fossulatus (N. 1901).
Ixodes thoracicus (N. 1901). Punta Arenas?

GALAPAGOS ISLANDS.

Amblyomma pilosum (=*hirtum*) (Bks. 1902; N. 1899 and 1906).
Argas transversa (Bks. 1902).

PERU.

Amblyomma maculatum (N. 1901).
Argas cucumerinus (N. 1901).

BOLIVIA.

Amblyomma cœlebs (N. 1906).
Amblyomma incisum (N. 1906).
Amblyomma oblongoguttatum (N. 1901).
Amblyomma parvitarsum (N. 1901).
Amblyomma scalpturatum (N. 1906).
Ixodes boliviensis (N. 1904).

BRAZIL.

Amblyomma albopictum (N. 1901).
Amblyomma americanum (N. 1901).
Amblyomma auriculare (Aragoa 1908).
Amblyomma brasiliense (Aragao 1908).
Amblyomma cajennense (N. 1901; Aragao 1908).
Amblyomma cajennense parviscutatum (N. 1901 and 1905; Aragao 1908).
Amblyomma calcaratum (N. 1901).
Amblyomma concolor (N. 1901; Aragao 1908).
Amblyomma denticulatum (N. 1901).
Amblyomma dissimile (N. 1901; Aragao 1908).
Amblyomma fossum (Aragao 1908).
Amblyomma fulvum (N. 1901).
Amblyomma geayi (N. 1901; Aragao 1908).
Amblyomma goldii (N. 1901).
Amblyomma humerale (N. 1901; Aragao 1908).
Amblyomma incisum (Aragao 1908).
Amblyomma infumatum (N. 1901).
Amblyomma longirostre (Aragao 1908).

Amblyomma lutzi (Aragao 1908).
Amblyomma maculatum (N. 1901; Aragao 1908).
Amblyomma naponensis (M. C. Z. Coll.) Type.
Amblyomma nodosum (N. 1901; Aragao 1908).
Amblyomma oblongoguttatum (N. 1901).
Amblyomma parvum (Aragao 1908).
Amblyomma perpunctatus (M. C. Z. Coll.) Type.
Amblyomma pictum (N. 1906).
Amblyomma rotundatum (N. 1901).
Amblyomma scalpturatum (N. 1906).
Amblyomma scutatum (N. 1901).
Amblyomma striatum (N. 1908).
Amblyomma varium (N. 1901; Aragao 1908).
Argas miniatus (March. and Salimb. 1903; Aragao 1908).
Hæmaphysalis cinnaberina (N. 1901; Aragao 1908).
Hæmaphysalis kochi (Aragao 1908).
Hæmaphysalis sanguinolenta (N. 1901).
Hyalomma longirostre (N. 1901).
Ixodes fuscipes (N. 1901; Aragao 1908).
Ixodes imperfectus (N. 1901).
Ixodes loricatus (N. 1901; Aragao 1908).
Ixodes thoracicus (N. 1901).
Ixodes variolatus (N. 1901).
Margaropus annulatus australis (N. 1901; Aragao 1908).
Ornithodoros megnini (Marx Coll.).
Ornithodoros talaje (Marx Coll.).
Rhipicephalus sanguineus (Aragao 1908).

PARAGUAY.

Amblyomma cajennense (N. 1901).
Amblyomma calcaratum (N. 1901).
Amblyomma dissimile (N. 1901).
Amblyomma maculatum (N. 1901).
Amblyomma ovale (N. 1901).
Amblyomma scutatum (N. 1901).
Margaropus annulatus australis (N. 1901; B. E. Coll.).
Ornithodoros coriaceus (N. 1901).

URUGUAY.

Amblyomma gypsatum (N. 1901).
Amblyomma maculatum (N. 1901).
Margaropus annulatus australis (N. 1901).

ARGENTINA.

Amblyomma auricularis (N. 1901; Lah. 1905).
Amblyomma cajennense (Lah. 1905).
Amblyomma dissimile (B. E. Coll.).
Amblyomma fossum (N. 1901; Lah. 1905).
Amblyomma maculatum (N. 1901; Lah. 1905).
Amblyomma testudinis (=*argentinæ*) (N. 1905; Lah. 1905).
Amblyomma varium (N. 1901; Lah. 1905).
Ceratixodes putus (Lah. 1905).
Dermacentor triangulatus (N. 1901).
Hæmaphysalis lagotis (Lah. 1905).
Ixodes loricatus (N. 1901; Lah. 1905).
Ixodes sp. (not *angustus*) (N. 1901; Bks. Rev.).
Margaropus annulatus australis (N. 1901; Lah. 1905).

CHILE.

Amblyomma inflatum (N. 1901).
Amblyomma maculatum (N. 1901).
Amblyomma parvitarsum (M. C. Z. Coll.).
Amblyomma varium (N. 1901).
Hæmaphysalis lagotis (N. 1901).
Margaropus annulatus australis (N. 1905).
Ornithodoros reticulatus (N. 1901).
Ornithodoros talaje (N. 1901).

PATAGONIA.

Amblyomma parvitarsum (Neum. 1901).
Aponomma læve (N. 1901).

CAPE HORN.

Ceratixodes putus (N. 1901 and 1904).

TERRE DEL FUEGO.

Ceratixodes putus (N. 1902).
Ixodes auritulus (N. 1904).
Ixodes loricatus (N. 1901).

It is hoped that most of the records based upon mistaken identifications have been eliminated. There are, however, several records which have been included that the writer considers questionable. These have been followed by interrogation points. The records of *Amblyomma cajennense* and *Dermacentor nitens* from Arizona are based upon specimens in Mr. Banks' collection which were found in a jar with *Margaropus annulatus,* with a label to the effect that they had

been taken from jack rabbits at Fort Bowie. The fact that *M. annulatus* does not attach to this host and that *D. nitens* has not been recorded from the rabbit is in the writer's opinion sufficient to regard these records with doubt. As no proof of the occurrence of *Argas reflexus* in this country has as yet been brought forth, the species is omitted from the list.

Neumann's records of the occurrence of the species of Dermacentor and Ixodes have been changed to agree with Banks' Revision so far as possible; in a number of instances there has been a question as to the species which he had at hand.

A Locality List of the Species Which Occur in the United States

Amblyomma americanum (Linnaeus, 1758).

Type locality: Pennsylvania or New Jersey.

Labrador, Massachusetts, New York, New Jersey, Pennsylvania, District of Columbia, Virginia, North Carolina, Florida, Michigan, Kentucky, Missouri, Arkansas, Louisiana, Oklahoma, Texas, Guatemala, Guiana, Brazil.

Amblyomma cajennense (Fabricius, 1794).

Type locality: Cayenne (French Guiana).

Florida, Texas, Arizona, California, Mexico, Guatemala, Honduras, Nicaragua, Costa Rica, Panama, Bermudas, Cuba, Jamaica, Trinite, Colombia, Venezuela, French Guiana, Brazil, Paraguay, Argentina.

Amblyomma dissimile (Koch, 1844).

Type locality: Mexico.

Texas (accidental), Mexico, Philippine Islands, Guatemala, Honduras, Nicaragua, Antigua, Barbados, Trinidad, Colombia, Venezuela, Guiana, Brazil, Paraguay, Argentina.

Amblyomma maculatum (Koch, 1844).

Type locality: Carolina.

Virginia, Carolina (North or South), Florida, Tennessee, Louisiana, Texas, California, Mexico, Jamaica, Ecuador, Peru, Brazil, Paraguay, Uruguay, Chili, Argentina.

Amblyomma tuberculatum (Marx, 1894).

Type locality: Florida. Type in the Marx collection.

Florida, Alabama, Cuba.

APONOMMA INORNATA (BANKS, 1909).

Type locality: Texas. Types in the B. E. collection.
Florida, Texas.

ARGAS BREVIPES (BANKS, 1908).

Type locality: Arizona. Types in the B. E. collection.
Arizona.

ARGAS MINIATUS (KOCH, 1844).

Type locality: Demerara (British Guiana).

Florida, Iowa, Texas, New Mexico, Arizona, California, Mexico, Cuba, Antigua, Martinique, Trinidad, Guiana, Brazil.

CERATIXODES PUTUS (CAMBRIDGE, 1876).

Type locality: Kerguelen Island. (Antarctic Ocean.)

Alaska, Aleutian Islands, St. Paul Island, Bering Island, St. Pierre and Miquelon Islands, Baffin Land, British Columbia, Argentina, Cape Horn, Terre del Fuego.

CERATIXODES SIGNATUS (BIRULA, 1895).

Type locality: Unalaska Islands. Cotype? in Banks' collection.
Aleutian Islands, Bering Island, California.

DERMACENTOR ALBIPICTUS (PACKARD, 1869).

Type locality: District of Columbia and Nova Scotia.

Nova Scotia, British Columbia, New Hampshire, Massachusetts, New York, District of Columbia, Michigan, Nebraska, Montana, Idaho, Nevada, Washington.

DERMACENTOR MARGINATUS (BANKS, 1908).

Type locality: Arizona. Types in Banks' collection.
Texas, Arizona.

DERMACENTOR MODESTUS (BANKS, 1909).

Type locality: Idaho and Washington. Types in the B. E. collection.

Idaho, Washington.

DERMACENTOR NIGROLINEATUS (PACKARD, 1869).

Type locality: New York. Type in M. C. Z. collection.
New York, Wisconsin, Texas.

DERMACENTOR NITENS (NEUMANN, 1897).

Type locality: Jamaica and San Domingo. Cotype in Marx collection.

Texas, Arizona ?, Guatemala, Costa Rica, Cuba, Jamaica, Haiti, San Domingo, Trinidad.

DERMACETOR OCCIDENTALIS (NEUMANN, 1905).

Type locality: California. Cotype in Marx collection.

Texas ?, New Mexico ?, Arizona, California.

DERMACENTOR PARUMAPERTUS (NEUMANN, 1901).

Type locality: California. Type in Marx collection.

Arizona, California.

DERMACENTOR VARIABILIS (SAY, 1821).

Type locality: Not recorded. Type lost.

Alaska, Labrador, Vermont, Massachusetts, New York, Pennsylvania, Maryland, District of Columbia, Virginia, North Carolina, Florida, Michigan, Ohio, West Virginia, Kentucky, Tennessee, Alabama, Minnesota, Iowa, Louisiana, North Dakota, Kansas, Oklahoma, Texas, Montana ?, Colorado, New Mexico, Arizona, California, Mexico.

DERMACENTOR VENUSTUS (BANKS, 1908).

Type locality: Northwestern United States. Types in Marx collection.

British Columbia, Texas, Montana, Wyoming, Colorado, New Mexico, Idaho, Utah, Nevada, Washington.

HAEMAPHSALIS CHORDEILIS (PACKARD, 1869).

Type locality: Massachusetts.

Vermont, Massachusetts, New York, Texas.

HAEMAPHYSALIS LEPORIS-PALUSTRIS (PACKARD, 1869).

Type locality: North Carolina.

Massachusetts, New York, Virginia, North Carolina, Florida, Alabama, Minnesota, Louisiana, Kansas, Oklahoma, Texas, Colorado, Nevada, Arizona, California, Mexico.

IXODES AEQUALIS (BANKS' MSS.).

Type locality: California. Type in Banks' collection.

California.

IXODES ANGUSTUS (NEUMANN, 1899).

Type locality: Idaho. Type in B. A. I. collection.

Alaska, British Columbia, Iowa, Idaho, Oregon, California.

IXODES ARCTICUS (OSBORN, 1899).

Type locality: Pribilof Islands. Type (in Nat. Mus. collection) mislaid.

Pribilof Islands.

IXODES BRUNNEUS (KOCH, 1844).

Type locality: North America.
Massachusetts, Maryland, North Carolina, Texas, California.

IXODES CALIFORNICUS (BANKS, 1904).

Type locality: California. Type in the B. E. collection.
California.

IXODES COOKEI (PACKARD, 1869).

Type locality: Massachusetts. Types in M. C. Z. collection.
Ontario, Maine, Massachusetts, New York, New Jersey, Pennsylvania?, Maryland, District of Columbia, Michigan, Minnesota, Iowa, Louisiana, South Dakota, Kansas, Texas, Colorado, Washington.

IXODES DENTATUS (NEUMANN, 1899).

Type locality: Maryland. Type in Marx collection.
Maryland, Virginia.

IXODES DIVERSIFOSSUS (NEUMANN, 1899).

Type locality: New Mexico. Type in Hassall collection.
New Mexico, Mexico.

IXODES HEXAGONUS (LEACH, 1815).

Type locality: Europe.
Maryland, Kansas, Europe.

IXODES MARXI (BANKS, 1908).

Type locality: Several of the states. Type in Banks' collection.
Ontario, New York, District of Columbia, Michigan, Ohio, Colorado.

IXODES PRATTI (BANKS, 1908).

Type locality: Texas and California. Types in the B. E. collection.
Texas, California.

IXODES RICINUS (LINNAEUS, 1758).

Type locality: Sweden.
Kansas, Texas, California?, Europe.

IXODES SCAPULARIS (SAY, 1821).

Type locality: Not recorded. Type lost.
Pennsylvania?, Maryland, Virginia, North Carolina, South Carolina, Florida, Indiana, Iowa, Missouri, Louisiana, Texas, Costa Rica.

IXODES SCULPTUS (NEUMANN, 1904).

Type locality: California. Type in Marx collection.
Texas, California.

IXODES TEXANUS (BANKS, 1909).

Type locality: Texas. Type in the B. E. collection.

Texas.

MARGAROPUS ANNULATUS (SAY, 1821).

Type locality: Florida. Type lost.

District of Columbia (accidental), Virginia, North Carolina, South Carolina, Georgia, Florida, Michigan (accidental), Illinois (accidental), Kentucky, Tennessee, Alabama, Mississippi, Missouri, Arkansas, Louisiana, Kansas (accidental), Oklahoma, Texas, New Mexico, Arizona, California, Mexico, Cuba.

ORNITHODOROS CORIACEUS (KOCH, 1844).

Type locality: Mexico.

California, Mexico, Paraguay.

ORNITHODOROS MEGNINI (DUGES, 1883).

Type locality: Mexico.

Kentucky, Iowa, Louisiana, Nebraska, Kansas, Oklahoma, Texas, New Mexico, Idaho, Nevada, Arizona, California, Mexico, Brazil.

ORNITHODOROS TALAJE (GUERIN, 1849).

Type locality: Guatemala.

Florida, Texas, California, Mexico, Hawaii, Guatemala, Colombia, Venezuela, Brazil, Chili.

ORNITHODOROS TURICATA (DUGES, 1883).

Type locality: Mexico.

Florida, Texas, New Mexico, Arizona, California, Mexico, Honduras, Jamaica, Venezuela.

RHIPICEPHALUS TEXANUS (BANKS, 1908).

Type locality: Texas. Types in the B. E. collection.

Texas, New Mexico?, Mexico, Panama, Haiti.

While these lists come far from recording the actual distribution of many of the species and include records of accidental distribution of others, it is at once evident that they are more or less limited to climatical zones, being most abundant in the Lower Austral and Tropical Zones and least so in the Boreal Zone. *M. annulatus, A. cajennense, A. maculatum, D. nitens* and *A. miniatus* appear to be limited to the Tropical and Lower Austral Zones; *A. tuberculatum* to the Tropical and Gulf Strip of the Lower Austral Zones, while *A. dissimile* only occurs in the Tropical Zone. Our two species of

Ceratixodes (*putus* and *signatus*) apparently occur in the Boreal Zone only. Many of the species which occur in this country appear to be limited to the Transitional and Austral Zones, but a more extensive collection is necessary to determine their exact distribution.

The host relations of ticks are an important factor to be considered in the study of their geographical distribution. Some species remain attached for long periods and can be carried great distances. The males in many species remain upon the host long after the females, which attached at the same time, have dropped. Many records have been based upon such accidental introduction of the species with the host and should not be considered in determining the normal distribution of the species. Unless the species can reproduce itself and continue reproduction from year to year it should be looked upon as an accidental introduction and temporary resident. In such instances man is usually responsible for the introduction, which is largely upon domestic animals. Thus *Margaropus annulatus* has frequently been introduced into the northern states, where it can reproduce during the summer, but is killed by the cold of winter. It was found by Banks in a collection from Michigan, where it had been taken from ponies. *Amblyomma dissimile,* which was introduced into Brownsville, Texas, from the Isthmus of Tehuantepec, on iguanas, is another instance of an accidental introduction which will probably fail to become established.

A more extensive collection will undoubtedly show a much wider distribution and common occurrence of many of the species here recorded. For the present the determination of their normal distribution must be based upon the frequence of their occurrence, particularly that of females.

Explanation of Abbreviations

Aragao 1908.=Included in a list of Brazilian ticks furnished the writer by Dr. Henrique B. Aragao.

B. A. I. Coll.=In the collection of the Bureau of the Animal Industry, U. S. D. A.

B. A. I. Quar. Area=Included in the area quarantined by the Bureau of Animal Industry, U. S. D. A.

B. E. Coll.=In the collection of the Bureau of Entomology, U. S. D. A.

Bks. Coll.=In the private collection of Mr. Nathan Banks.

Bks. Rev.=Recorded in Banks' Revision of the Ixodoidea.

Bks. 1902=Banks' account in Papers from the Hopkins Stanford Galapagos Expediton, 1898–1899, Proc. Wash. Acad. Sci. IV.

C. S. Bks. 1904=Recorded in C. S. Banks' paper on the Australian Tick in the Philippine Islands.

C. H. T. T. No. 69=Notes (by C. H. T. Townsend) from the Institute of Jamaica No. 69 (1893).

C. H. T. T. No. 71=*Ibid.* No. 71 (1893).

Fitch 1872=Recorded in the Fourteenth Report of the Noxious, Beneficial and Other Insects of the State of New York.

Garman Coll.=In the collection received from Prof. H. Garman.

Hadley 1909=Recorded in notes by P. B. Hadley, Science, N. S., vol. XXX, No. 774, pp. 605–606.

Hass. Coll=In the collection of Dr. A. Hassall.

Hook Notes 1909=Noted by the writer in an article in the JOURNAL OF ECONOMIC ENTOMOLOGY II, pp. 251–257.

H. and H. Bull.=Recorded in Bulletin No. 72 of the Bureau of Entomology, by Hunter and Hooker.

Hubbard 1894=Recorded in Insect Life, vol. VI, p. 306, by H. G. Hubbard.

Jo. Inst. Jam.=Recorded in the Journal of the Institute of Jamaica.

Lah. 1905=Recorded in Dr. F. Lahille's work entitled "Contribution a L'étude des Ixodidés de la République Argentine."

Leidy 1890=Recorded in the Proceedings of the Academy of Natural Sciences of Philadelphia, 1890.

Lewis 1908=Recorded in the Oklahoma Agricultural Experiment Station Bulletin 81, by L. L. Lewis.

March. and Salimb.=Recorded in the work of Drs. E. Marchoux and A. Salimbeni on "La Spirillose des Poules."

Mass. A. C. Coll.=In the collection of the Massachusetts Agricultural College.

Marx Coll.=In the Marx collection of the U. S. National Museum.

Mayo 1906=Recorded by Dr. N. S. Mayo in First. Ann. Rept. Agr'l Exp. Sta., Cuba, p. 44.

Mich. A. C. Coll.=In the collection of the Michigan Agricultural College.

M. C. A. Coll.=In the collection of the Museum of Comparative Zoölogy, Cambridge, Mass.

Morgan 1899=Recorded by Prof. H. A. Morgan in Bulletin No. 56 of the La. Agr'l Exp. Station.

N. 1897=In Dr. L. G. Neumann's Révision de la famille des Ixodidés II.

N. 1899=*Ibid.* III.

N. 1901=*Ibid.* IV.

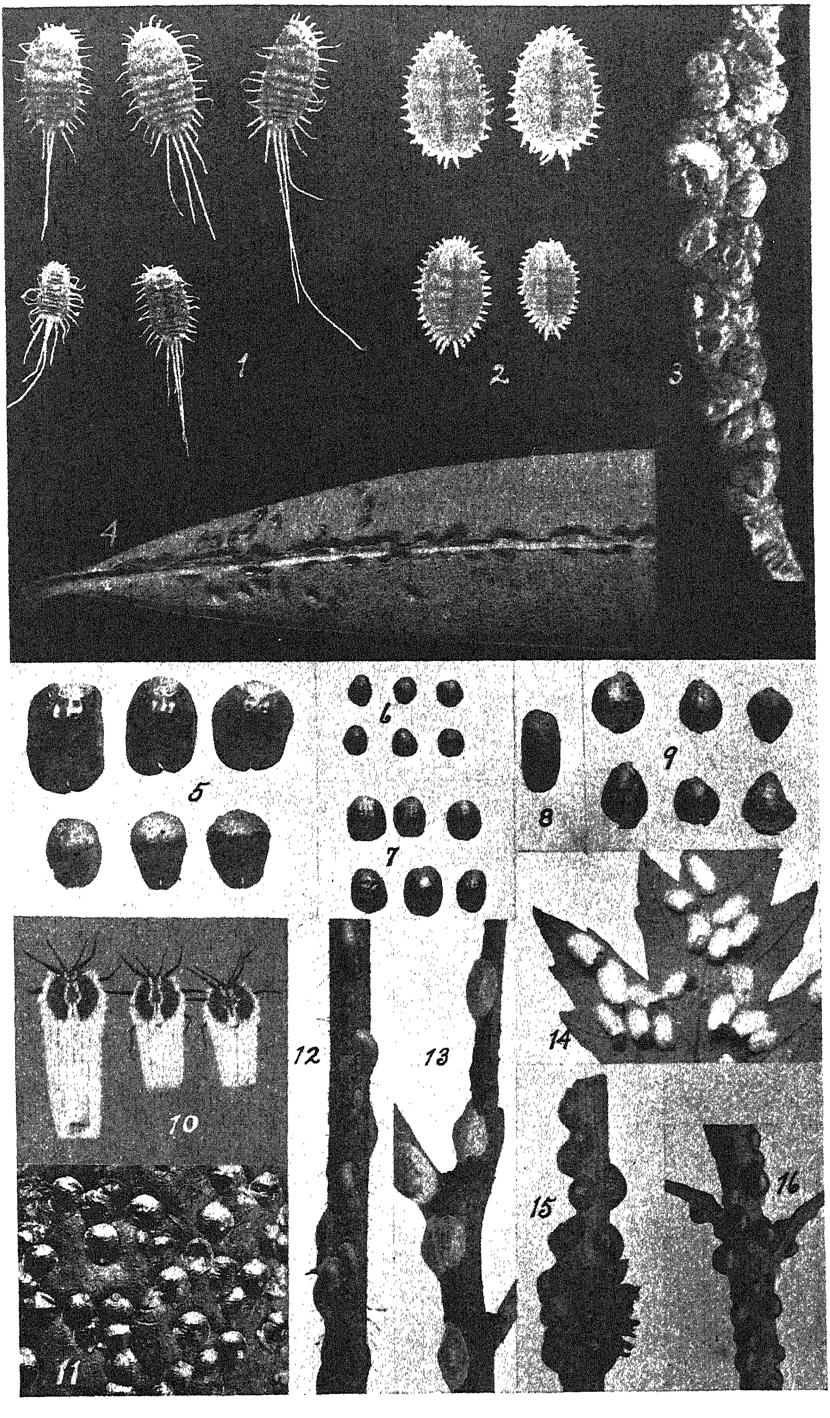
N. 1902=In Neumann's Notes sur les Ixodidés I.
N. 1904=*Ibid.* II.
N. 1906=*Ibid.* IV.
Newell Coll.=In the collection of Prof. Wilmon Newell.
Niles 1900=Recorded by Dr. E. P. Niles in Bulletin No. 114 of the Va. Agr'l Exp. Station.
N. Y. S. M. Coll.=In the collection of the New York State Museum.
Osb. Coll.=In the collection of Prof. Heibert Osborn.
Pack. Amer. Nat. 1868=Recorded in American Naturalist, Vol. II.
Pack. Ann. Rep. 1869=Recorded in First Annual Report of the Peabody Academy of Science.
Pack. Amer. Nat. 1869=Recorded in American Naturalist, Vol. III.
Pack. Guide=Recorded in Packard's Guide to the Study of Insects.
S. and S. 1901=Recorded in Salmon and Stiles work on Cattle Ticks.
Say 1821=Recorded by Say in the Journ. Acad. Nat. Sci. of Phila. II.
Sim. Aub. and Noc. 1909=Recorded in article by Simond, Aubert and Noc in Comp. Rend. Soc. Biol., Paris, Vol. 66.
Stiles Coll.=In the collection of Dr. C. W. Stiles.
Washb. Coll.=In the collection received from Prof. F. L. Washburn.
W. and W. 1909=Recorded by Drs. W. B. Wherry and D. C. Wellman in Entomological News, Vol. XX, p. 376 (1909).

THE IDENTITY AND SYNONYMY OF SOME OF OUR SOFT SCALE-INSECTS

By J. G. Sanders, *Bureau of Entomology, Washington, D. C.*

So much confusion and misapprehension concerning the identity and classification of our soft scales has arisen during the past score of years that the average entomologist has been unable to determine the common species with any degree of certainty. This deplorable condition of our knowledge of this group of scale insects has been to a great extent the result of injudicious and hasty conclusions combined with scattered, meagre, unillustrated descriptions.

There has always been a tendency among entomologists, in dealing with insects belonging to the lower groups of Homoptera—Coccidæ, Aleyrodidæ, Aphididæ—to lay too much stress upon the particular host plant involved. The fact that a certain colony of insects, although apparently quite similar to another colony on its normal food plant, is found on a new food plant has influenced many entomologists to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describe as a new species the colony on the supposedly abnormal food plant.

Again, variations in size, color and vestiture have misled many to describe a mere variation as a new species or variety. Then, too, it was generally conceded by the early entomologists that the same species of such sedentary insects as coccids could not live on different food plants especially if the hosts belonged to different genera. A sentence in Fitch's original note-book expresses his views on this subject, when he describes the common oyster-shell scale as a new species because he found it on the dogwood (*Cornus stolonifera*), and adds: "Certainly there is the same ground for deeming the species of this genus, which occur upon plants of different genera, to be distinct species, that there is in the genus *Lecanium*." As the result of this idea, there are more than forty species and many more varieties of the genus *Lecanium* described in Fitch's note-book; but fortunately the majority of these descriptions never appeared in print. This idea, prevailing in the time of Linnæus, Geoffroy, Gmelin, Modeer, Fabricius, Burmeister, Schrank, Bouché and Boisduval, has resulted in the publication of a multitude of descriptions of supposedly new species, many of which have been subsequently reduced to synonymy. Unfortunately many of these names still remain as valid species in our catalogues; especially in the non-diaspine groups, and more especially those species of the genus *Lecanium*. Moreover, within the last decade or two, many species have been described and published here and there, from insufficient material, and without the careful study and comparison with other species which are nearly related, and with but little regard for the individual variations which are bound to appear in insects so absolutely dependent upon the kind and condition of their host plants as are the sedentary scale-insects. It is most unreasonable to expect to find a perfectly formed and fully developed Lecanium or Pulvinaria on a twig or stem of 1-16 inch diameter on a starved plant, when the normal form would appear only on the flat surface of a leaf or a large stem in vigorous growth. Prof. Robert Newstead in his Monograph of the British Coccidæ and more recently Dr. Paul Marchal, of Paris, have done some valuable work in the reduction of the synonyms of the early students of scale insects, and there is still much to be done.

The writer has been especially fortunate during the past five years to have access to the finest collection of Coccidæ in the world; a collection several times the value of any other in existence on account of the large percentage of type and cotype material; the national collection at Washington at the present time containing upwards of

850 types and cotypes, material of many other species, and thousands of slide preparations. The loan of the important Coccid collection of the late Wm. Maskell, of New Zealand, and the study of his types, have cleared up several doubtful classifications and confirmed several synonyms.

The following discussion of species and synonyms will necessarily be brief and general and will include only the more common species occurring in this country, with occasional references to their distribution in foreign countries. In a subsequent paper to be published by the U. S. Bureau of Entomology, the writer will review the genus *Lecanium* and discuss more fully the identity and synonymy of the species.

The writer retains the name *Lecanium* for some of those species which have been classified under *Eulecanium*, because it is impossible to eliminate *Lecanium* from our Coccid nomenclature. At least one species of the several included by Burmeister under his genus in the original description in Handbuch der Entomologie, II Band, p. 69 (1835), must be retained as the type. All the species which Burmeister really placed under his genus have been removed to other genera except *persicæ*, which should be considered the type. *Eulecanium* becomes a synonym of *Lecanium*.

This paper is submitted for publication with the permission of Dr. L. O. Howard, Chief of Bureau.

The Greenhouse Orthezia

Orthezia insignis Dougl.

Plate 19, Fig. 10

Orthezia insignis Dougl., Jn. Quekett Micr. Club, p. 169 (1887).
Orthezia nacrea Buckton, Ind. Mus. Notes, III, 3, p. 103 (1894).

In tropical regions this scale insect is generally known as the Lantana bug, because of its predilection for that plant. It occurs only in greenhouses in temperate regions, where it attacks principally Lantana, Coleus, Citrus spp., Verbena, Chrysanthemum, Ipomoea, Capsicum, etc., and is a difficult pest to eradicate.

The adult female with her fully developed, fluted white ovisac and marginal fringe of white waxy laminæ is a beautiful insect. This species is readily distinguished from all other species of the genus by the large area of the dorsum which is without a waxy covering, revealing the dark green body color.

All the species of this genus bear these white waxy laminæ in characteristic arrangement.

The Pit-Making Oak Scale

Asterolecanium variolosum (Ratz.)

Plate 19, Fig. 11

Coccus variolosus Ratz., Tharander Jahrbuch, p. 187 (1870).
Asterolecanium quercicola Sign., An. Soc. Ent. Fr., 4, X, p. 279 (1870).
Lecanium quercicola Altum, Forstzoölogie, III, pt. 2, p. 365 (1882).
Asterodiaspis quercicola Rübs., Berl. Ent. Zeit., XXXIX, p. 200 (1894).
Coccus quercicola Eckst., Forstzoölogie, p. 556 (1897).
Asterolecanium variolosum Ckll., Pr. Ac. N. Sci. Ph., p. 269 (1899).

This species is the only one of its genus which is found outside of greenhouses in the northern section of this country. It is a native of the Palearctic region and lives only on various species of oaks.

There have been many references in literature to this scale under the name *A. quercicola* Bouché, but Bouché's original description undoubtedly refers to what is known as *Aspidiotus zonatus* Frauenf. Ratzeburg's description of *variolosum* is good and is illustrated by fair figures.

Reports are at hand of its occurrence in Massachusetts, Connecticut, New York, Pennsylvania, Ohio, Michigan, Maryland, New Jersey, Virginia, North Carolina, District of Columbia and Ontario.

This scale is nearly circular in outline and somewhat convex, delicately ridged transversely, and yellowish-green to bronze green in color when alive. After the death of the female the body shrinks, and becomes reddish brown, the color showing through the anterior part of the test. Diameter about 2 mm. The adult female lacks legs and antennæ and exhibits few microscopic characters other than the marginal row of figure 8 pores.

The Long-Tailed Mealy Bug.

Pseudococcus adonidum (Linn.).

Plate 19, Fig. 1

Coccus adonidum Linn., Syst. Nat., Ed. XII, p. 140 (1767).
Pseudococcus adonidum Westw., Mod. Class. Ins., I, Synop., p. 118 (1839).
Coccus liliacearum Bouché, Stett. Ent. Zeit., p. 300 (1844).
Coccus tuliparum Bouché, Stett. Ent. Zeit., p. 301 (1844).
Coccus zamiæ Lucas, Bul. Soc. Ent. Fr., 3, V, p. CVII (1855).
Dactylopius longispinus Targ., Catalogue, p. 32 (1869).
Dactylopius hoyæ Sign., An. Soc. Ent. Fr., 5, V, p. 317 (1875).
Dactylopius pteridis Sign., An. Soc. Ent. Fr., 5, V, p. 321 (1875).
Dactylopius longifilis Comst., Rep. U. S. Dep. Agr., 1880, p. 344 (1881).

The general appearance of this soft, mealy, segmented scale-insect is well shown in the accompanying plate. There are but few species

of this genus exhibiting the very long caudal waxy filaments, and one is pretty safe in identifying as this species the common longtailed mealy-bugs of our greenhouses. It occurs on many plants but its range of hosts is hardly as great as that of the short-tailed species, *Pseudococcus citri*.

There are seventeen white waxy marginal filaments of various lengths on each side of the body which is covered lightly with powdery wax. The four posterior filaments are sometimes longer than the body. The segments are quite distinct. On each side of the anal lobes are two microscopic sharp spines surrounded by a circle of closely-grouped pores, easily distinguishable from the scattered arrangement in *citri*.

There is no reason why Linnæus' name of this insect should be discarded in favor of *longispinus* Targ., when we have such a good description of the insect in Systema Naturæ, Ed. XII, even though the name had been used previously in Fauna. Suecica and omitted from Ed. X.

Bouché's species *liliacearum* and *tuliparum* are undoubtedly synonyms differing according to description only in size, and both occur on plants of the same group and under similar conditions. Bouché says they are near *adonidum*. *Coccus zamiæ* Lucas was described from *Zamia australis* and *Z. spiralis*, plants originally from Australia, but growing for some time in the Paris Botanic Gardens where *adonidum* was abundant. The writer has seen *Zamia* sp. literally covered beneath with *Pseud. adonidum* and *Saissetia hemisphærica* (Targ.).

Maskell in 1895 [Ann. Mag. N. H., 6, XVI, p. 133 (1895)] considered *Dact. liliacearum*, *D. tuliparum* and *D. hoyæ* to be synonyms of *D. adonidum* (Linn.).

The Short-Tailed Mealy Bug

Pseudococcus citri (Risso)

Plate 19, Fig. 2

Dorthesia citri Risso, Essai, Hist. Nat. des Oranges (1813).
Coccus citri Bdv., Ent. Hort., p. 348 (1867).
Dactylopius citri Sign., An. Soc. Ent. Fr. (5), v. p. 312 (1875).
Lecanium phyllococcus Ashm., Can. Ent., XI, p. 160 (1879).
Dactylopius brevispinus Targ., Annali di Agr., p. 137 (1881).
Dactylopius destructor Comst., Rep. U. S. Dep. Agr., 1880, p. 342 (1881).
Pseudococcus citri Fernald, Cat. of Coccidæ, p. 99 (1903).

This very common mealy-bug infests so many species of plants that it would be much easier to list those not affected, so omnivorous is it

in habit. The accompanying photograph will convey an idea of its superficial appearance more accurately than description. When many specimens are massed on a plant the filaments are disarranged and intermingled so that the characteristic appearance is somewhat lacking. The mid-dorsal longitudinal brownish band is quite characteristic of this species. The microscopical characters of the anal lobes readily distinguish it from *adonidum*, by the two spines and scattered pores as contrasted with the closely grouped pores in the latter species.

The ovisacs of *citri* as well as *adonidum* are normally of a flattened cylindrical form constructed of loose waxy threads, but when the insects are crowded the ovisacs are irregularly massed.

This scale has been a pest in citrus groves in southern Europe for many years, and now its damage is assuming alarming proportions in the lemon groves of southern California. Every greenhouse propagator knows this insect as a pernicious and aggravating pest.

The Cottony Maple-Scale

Pulvinaria vitis (Linn.)

Coccus vitis Linn., Syst. Nat., Ed. X, 1, p. 456 (1758).
Coccus innumerabilis Rathv., Penn. Farm Journ., p. 256 (1854).
Lecanium pyri Fitch (in part), Tr. N. Y. Agr. Soc., p. 809 (1854).
Lecanium macluræ Fitch, Country Gentleman, V, p. 38 (1855).
Lecanium acericorticis Fitch, 6th Rep. Ins. N. Y., p. 775 (1859).
Lecanium acerella Rathv., Lancaster Farmer, p. 101 (1876).
Pulvinaria innumerabilis var. *occidentalis* Ckll., The Entom., XXX, p. 13 (1897).
Pulvinaria innumerabilis var. *tiliæ* King & Ckll., Psyche, VIII, p. 286 (1898).
Pulvinaria hunteri King, Can. Ent., XXXIII, p. 144 (1901).
Pulvinaria simplex King, Mitth. Schw. Ent. Ges. (10), X, p. 475 (1903).

This is a well known scale in the United States, which in Europe is popularly known as the vine cottony scale. It is one of the most conspicuous scales of this country when the ovisac of the female is fully developed, and is considered a variable pest from year to year. The periodicity of its appearance in dangerous numbers is due directly to the rise and fall in numbers of its parasites and natural enemies.

This scale is discussed and figured in Bulletin No. 22, n. s., and in Circular No. 64, U. S. Bureau of Entomology, under the name of *Pulvinaria innumerabilis* Rathv., but a careful study of our insect in this country reveals absolutely no differences from the common European species, *P. vitis* (Linn.). Fitch's types have also been compared, resulting in the above synonymy. A study of several supposed species and varieties of Pulvinaria, consisting of transplantings

of young crawling larvæ from various hosts in different parts of the country to other hosts, and the subsequent changes in size and outward appearance, has convinced the writer that the host plant has an unexpectedly potent influence in the development of the insect. During the great outbreak of this scale in Chicago and vicinity in 1906, the writer brought from Chicago twigs of maple and box-elder with hundreds of the egg-sacs filled with eggs, and tied the twigs to a number of kinds of trees. In due time the eggs hatched and many of the larvæ set and molted and developed very satisfactorily on their new food plants, while on some trees a large percentage failed to develop.

The following spring and early summer brought forth a revelation in the various sizes, colorations and markings of the rapidly developing females on the various food plants. On young rapidly growing sycamore (*Platanus occidentalis*) and linden (*Tilia americana*) which were well cared for in large pots, the adult females just before the formation of the ovisac averaged 8 mm. in length and 6 mm. in breadth, and were mottled and marked with unusual brilliancy. The smallest females obtained in this experiment were grown on boxwood (*Buxus sempervirens*) and averaged but 2.75 mm., while but four specimens reached maturity. Transplantings were successful on apple, pear, quince, mulberry. grape, osage-orange, poison ivy (*Rhus toxicondendron*), *Ampelopsis tricuspidata*, plum, boxwood, spiræa, maple, box-elder, *Viburnum prunifolium*, *Quercus coccinea*, *Ptelea*

EXPLANATION OF PLATE 19

1. *Pseudococcus adonidum* Linn.
2. *Pseudococcus citri* Risso.
3. *Toumeyella liriodendri* Gmel.
4. *Coccus hesperidum* Linn. on Oleander leaf.
5. *Lecanium caryæ* Fitch.
6. *Lecanium nigrofasciatum* Pergande.
7. *Lecanium corni* Bouché.
8. *Lecanium persicæ* (Fab).
9. *Lecanium quercifex* Fitch.

   Nos. 5–9 are natural size and photographed simultaneously.

10. *Orthezia insignis* Dougl.
11. *Asterolecanium variolosum* (Ratz.) on Oak.
12. *Coccus elongatus* (Sign.) on Mimosa.
13. *Neolecanium cornuparvum* (Thro) on Magnolia twig.
14. *Pulvinaria acericola* Walsh & Riley.
15. *Lecanium corni* Bouché on Honeysuckle.
16. *Saissetia hemisphærica* (Targ.) on *Persea gratissima*.

trifoliata, honey locust, American elm and hackberry (*Celtis occidentalis*). The superficial appearance of the adult females on different host plants varied remarkably as did also the size and bulk of the ovisacs.

Further study may reveal other synonyms of this species in the United States and Europe. Newstead, in his Monograph of British Coccidæ, has reduced many species names of the early authors to synonymy with *P. vitis.*

The Cottony Maple-Leaf Scale

Pulvinaria acericola (Walsh & Riley)

Plate 19, Fig. 14

Lecanium acericola W. & R., Amer. Ent., I, p. 14 (1868).
Pulvinaria acericola Ckll., Check List, p. 329 (1896).

This species in the adult stage is usually found only on the leaves of maple, while *P. vitis* occurs invariably on the branches or twigs of its host. This habit means that the latter species, which develops in the younger stages on the leaves and migrates to the twigs before the falling of the leaves, changes location but once, while *P. acericola* migrates twice during its life history, *i. e.,* from leaf to twig in autumn, and back to the new leaves in the following spring.

The females of *acericola* are very distinct from *vitis* in the more adult stages, having small patches of cottony wax on the dorsum, and developing a very long, fluted ovisac, which is narrower than that of *vitis.* The microscopic characters are also distinctly different. A complete illustrated discussion of the life history and habits of this scale-insect appeared in Bulletin 22, n. s., U. S. Bureau of Entomology in 1900.

The Tessellated Scale

Eucalymnatus tessellatus (Sign.)

Plate 20, Fig. 1

Lecanium tessellatum Sign., An. Soc. Ent. Fr., 5, III, p. 401 (1873).
Lecanium perforatum Newst., Ent. Mon. Mag., XXX, p. 233 (1894).
Lecanium tessellatum var. *perforatum* Ckll., Psyche, VIII, p. 90 (1897).
Eucalymnatus tessellatus Ckll., Ann. Mag. N. H., 7, IX, p. 453 (1902).
Lecanium subtessellatum Green, Cocc. of Ceylon, pt. III, p. 206 (1904).

This species infests a wide range of food plants and is almost unmistakable in appearance. It is exceedingly flat, usually asymmetrical, brown to dark brown, and reveals its remarkable tessellation to the unaided eye. Under the microscope the beautiful pattern is disclosed

and the derm appears as if composed of nicely fitted plates riveted together, so remarkable is the arrangement of small pores around the margins of the plates. The entire derm is full of pores of various kinds.

Newstead described a supposedly new species, called *perforatum* on account of a series of ten rather large pores in some of the posterior submarginal plates, which Signoret failed to mention in his description of *tessellatus,* a character which might easily have been omitted among the other more remarkable characters of this species. There are specimens of this species in the Fitch Collection at Washington from Signoret, and these all show the "perforations." The writer has examined hundreds of specimens of this species and all exhibit this same character.

Green in 1904 described from Ceylon, as *subtessellatum,* what he considered a new species, because the specimens he had at hand were apparently immature and lacked the strong tessellation in the mid-dorsal region. Later Mr. Green has recalled the species after examining a larger series of these scales, and considers the above synonymy as correct.

The Soft Brown Scale

Coccus hesperidum Linn.

Plate 19, Fig. 4

Coccus hesperidum Linn., Syst. Nat. Ed. X, I, p. 455 (1758).

Chermes hesperidum Geoff., Abr. Ins., I, p. 505 (1762).

Calypticus hesperidum Costa, Faun. Reg. Nap., Cocc., p. 8 (1835).

Calypticus lævis Costa, Faun. Reg. Nap., Cocc., p. 8 (1835).

Calymmatus hesperidum Costa, Nuov. Osserv., p. 22 (1835).

Coccus patelliformis Curt., Gard. Chron., p. 517 (1843).

Chermes lauri Bdv., Ent. Hort., p. 340 (1867).

Lecanium platycerii Pack., Rep. Mass. Bd. Agr., p. 260 (1870).

Lecanium angustatum Sign., An. Soc. Ent. Fr., 5, III, p 398 (1873).

Lecanium maculatum Sign., An. Soc. Ent. Fr., 5, III, p. 400 (1873).

Lecanium alienum Dougl., Ent. Mon. Mag., XXIII, p. 77 (1886).

Lecanium depressum var. *simulans* Dougl., Ent. Mon. Mag., XXIV, p. 28 (1887).

Lecanium minimum Newst., Ent. Mon. Mag., XXVII, p. 141 (1892).

Lecanium assimile var. *amaryllidis* Ckll., Tr. Am. Ent. Soc., XX, p. 53 (1893).

Lecanium terminaliæ Ckll., Jn. Inst. Jam., I, p. 254 (1893).

Lecanium nanum Ckll., Psyche, VII, Suppl., 1, p. 19 (1896).

Lecanium flaveolum Ckll., Psyche, VIII, pp. 52, 53 (1897).

Lecanium minimum var. *pinicola* Mask., N. Z. Trans., XXIX, p. 310 (1897).

Lecanium ventrale Ehrh., Can. Ent., XXX, p. 245 (1898).

Lecanium (Calymnatus) hesperidum pacificum Kuw., Jn. N. Y. Ent. Soc., X, p. 30 (1902).

Lecanium signiferum Green, Cocc. of Ceylon, pt. III, p. 197 (1904).

The fact that this scale has been redescribed so frequently under different names in various countries is alone proof of its exceptional importance to horticulturists and gardeners and of its widespread occurrence and great range of food plants. It is improbable that any other species of the soft scales is known to infest so many species of plants in widely divergent genera. In the writings of the very early European entomologists relating to scale insects, this species was always the preëminent one, from which we may assume that it was then the most important economic species of the region. At the present time it is a pest in those regions where it is permitted to multiply through the carelessness of man, or on account of favorable climate, or both combined.

The following description of the adult female by E. E. Green (Coccidæ of Ceylon, p. 188, 1904) is quite complete and furnishes an idea of some of the variations in markings, etc., which are found in this species.—"Adult female bright yellow or greenish-yellow, minutely specked with red-brown, the specks sometimes agglomerated into transverse bars, especially on the median abdominal region: in other parts tending to form dotted lines radiating from center to margin. In older examples the ground color may be ochreous or pale fulvous; and the maculation may form a broad median fascia. Under surface of older examples with a deep purple-brown or red patch covering the median abdominal area, becoming concave and forming a shelter for the young larvæ. Dried specimens straw-colored and much wrinkled. Form oblong-oval, often very irregular in outline; narrowest in front; more or less concave above according to age. In some individuals, generally on those protected by some shelter, I have noticed a double median longitudinal series of raised glassy points; but they appear to be very brittle and easily lost." Length, 2.5—5 mm.; breadth, 1.5—3 mm.

In view of the great variation in size, color and markings, there are plausible excuses for the frequent redescriptions of this cosmopolitan species under new names; but entomologists should take into account a certain probable variability in any insects they describe as new or otherwise.

Some of the above synonymy is here proposed for the first time, but several names have been reduced by Newstead, Green and Fernald. For the reduction of *angustatum*, *maculatum*, *terminaliæ*, *nanum*, *flaveolum*, *minimum*, var. *pinicola*, *ventrale*, *hesperidum* var. *pacificum*, and *signiferum*, the writer is responsible. These reductions are made only after very careful morphologic study with a high power microscope of typical material, and after biological study of the forms

so far as possible on many food plants. Resulting variations secured by transference to different food plants, were fully as remarkable as observed in the case of *Pulvinaria vitis* (L.).

The Long Soft Scale

Coccus elongatus (Sign.)

Plate 19, Fig. 12

Lecanium elongatum Sign., An. Soc. Ent. Fr., 5, III, p. 404 (1873).
Lecanium longulum Dougl., Ent. Mon. Mag., XXIV, p. 97 (1887).
Lecanium chirimoliæ Mask., N. Z. Trans., XXII, p. 137 (1889).
Lecanium ficus Mask., Ent. Mon. Mag., XXXIII, p. 243 (1897).
Lecanium frontale Green, Cocc. Ceylon, pt. III, p. 192 (1904).

This species is quite similar in general appearance to *C. hesperidum* with its color variations, but is elongate elliptical to varying degrees, depending upon the exigency of location; and is ordinarily rather more convex than the latter species. The eight-segmented antennæ will identify it easily from those of *hesperidum* with but seven. The latter species has but four fringe spines arranged in a transverse line about midway across the anal plates, while there are eight in *elongatus.*

The specific name *elongatum* Sign., takes precedence over *longulum* Dougl., since an examination of specimens from Signoret in the Fitch collection verifies this synonymy. *L. chirimoliæ* and *L. ficus* of Maskell are also synonyms. *L. frontale* Green has been a puzzle for some time because the writer could find no morphologic characters to differentiate it from *elongatus,* except its more narrow form. But the discovery of *elongatus* on leaves of Anthurium, Calophyllum and Croton exhibiting all the forms connecting the typical *elongatus* and typical *frontale* has cleared the situation. On these plants the young scale has settled close to the high midribs or larger veins and its development has been more linear than usual, resulting in the greater length of body anterior to the antennæ and posterior to the anal plates. In all microscopic characters—derm pores, antennæ, legs,

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Explanation of Plate 20

Photomicrographs showing characteristic derm pores; all at same magnification.

1. *Eucalymnatus tessellatus* (Sign.).
2. *Saissetia oleæ* (Bern.).
3. *Saissetia nigra* (Nietn.).
4. *Saissetia hemisphærica* (Targ.).
5. *Toumeyella liriodendri* (Gmel.).
6. *Neolecanium cornuparvum* (Thro).

marginal and spiracular spines, anal plates and spines—the similarity is evident.

The Hemispherical Scale

Saissetia hemisphærica (Targ.)

Plate 19, Fig. 16; Plate 20, Fig. 4

Lecanium hemisphæricum Targ., Studii sul. Cocc., pp. 26, 27, etc. (1867).
Chermes anthurii Bdv., Ent. Hort., p. 328 (1867).
Chermes filicum Bdv., Ent. Hort., p. 335 (1867).
Chermes hibernaculorum Bdv., Ent. Hort., p. 337 (1867).
Lecanium coffeæ Sign., Ann. Soc. Ent. Fr., 5, III, p. 435 (1873).
Lecanium beaumontiæ Dougl., Ent. Mon. Mag., XXIV, p. 95 (1887).
Lecanium clypeatum Dougl., Ent. Mon. Mag., XXV, p. 58 (1888).
Lecanium hemisphæricum var. *hibernaculorum* Ckll., Bul. Bot. Dep. Jamaica, p. 71 (1894).
Lecanium hemisphæricum var. *filicum* Green, Ent. Mon. Mag., XXXIII, pp. 70, 77 (1897).
Lecanium (*Saissetia*) *coffeæ* var. *clypeatum* Ckll. & Parr., The Industrialist, p. 164 (1899).
Saissetia hemisphærica Ckll., The Ent. Student, II, p. 32 (1901).
Coccus coffeæ Kirkaldy, Fauna Haw., III, pt. 2, p. 105 (1902).

The common name of this scale is descriptive of its form, although it is not exactly hemispherical but a little elongate and frequently higher than broad. The shape, smooth surface, brown color, and the minute pale dots of the skin which are easily seen with the aid of a hand-lens, will distinguish this common species. As in all species of this genus, the derm is filled with microscopic pores.

A number of species and varieties have been described by early authors which are now known to be synonyms. A form known as *filicum*, occurring on ferns has been held to be a different species, but a long study of this form and its transference from various hosts to ferns and vice versa indicates that not even varietal rank should be considered.

Mr. W. C. Thro, in Bul. 209, Cornell Univ. Agr. Exp. Sta., describes *filicum* as varying from *hemisphærica* in the number of "fringe spines" on the anal plates, but a careful examination of Mr. Thro's slides reveals the ordinary number of spines, although small, in his specimens which were immature.

This species is perhaps more widely (if possible) distributed throughout the world than *S. oleæ*, and infests a wider range of plant life. It occurs only in greenhouses in temperate regions.

The Olive Scale

Saissetia oleæ (Bern.)

Plate 20, Fig. 2

Chermes oleæ Bern., Mem. d'Hist. Nat. Ac. Marseille, p. 108 (1782).
Coccus olea Oliv., Ency. Meth., VI, p. 95 (1791).
Coccus palmæ Haw., Tr. Ent. Soc. Lond., p. 307 (1812).
Coccus testudo Curt., Gard. Chron., p. 444 (1843).
Coccus cycadis Bdv., Ent. Hort., p. 323 (1867).
Lecanium cassiniæ Mask., N. Z. Trans., XXIII, p. 15 (1890).
Lecanium oleæ var. *testudo* Ckll., Check List, p. 331 (1896).
Lecanium oleæ var. *mirandum* Ckll. & Parr., Biol. Centr. Am., II, pt. 2, p. 12 (1899).
Coccus oleæ Kirkaldy, Fauna Haw., III, pt. 2, p. 106 (1902).

In view of the fact that this species has been described and figured so frequently in various reports, it seems hardly necessary to describe it again in full. The popular name "black scale" has been applied to this species, but rather incorrectly, since it is usually very dark brown; the above name should be applied properly to *Saissetia nigra*, which in the adult female stage usually becomes truly black.

A thorough study of this species warrants the above synonymy, part of which Professor Newstead proposes and the remainder is vouched for by the writer after examining typical material. Maskell, in his notes, doubts the validity of his species, *cassiniæ*, and an examination of his types sinks the name.

This species is readily recognized by its thick convex, dark-brown scale dotted with minute flakes of wax, and bearing two more or less prominent transverse ridges and a median longitudinal ridge in the form of a letter H. The young female of the hemispherical scale sometimes exhibits this character to a slight degree, but it vanishes toward maturity.

The olive scale infests a wide range of food plants and is found in nearly every greenhouse where tropical plants are grown, and is a pest in the warmer regions of the United States.

The Black Scale

Saissetia nigra (Nietn.)

Plate 20, Fig. 3

Lecanium nigrum Nietn., "Enemies of Coffee-tree," p. 9 (1861).
Lecanium depressum Targ., Studii sul. Cocc., p. 29 (1867).
Lecanium begoniæ Dougl., Ent. Mon. Mag., XXVIII, p. 209 (1892).
Lecanium nigrum var. *depressum* Ckll., Check List, p. 332 (1896).
Saissetia depressa King, Psyche, IX, p. 296 (1902).

Saissetia nigra King, Psyche, IX, p. 296 (1902).
Saissetia nigrella King, Psyche, IX, p. 296 (1902).
Coccus nigrum Kirkaldy, Fauna Haw., III, pt. 2, p. 106 (1902).

This species is of less importance in the United States than either of the other species of this genus mentioned here. Its distribution has been effected to all quarters of the globe, occurring on many different plants. In some of the West Indian Islands it is a very important cotton pest and difficult to control.

It is included in this paper principally to record its synonyms which have been described from various regions and until recently held as distinct species.

The European Peach Scale

Lecanium persicæ (Fab.)

Plate 19, Fig. 8

Chermes persicæ Fab., Gen. Ins. Mant., p. 304 (1776).
Chermes clematitis Gmel., Syst. Nat., Ed. XIII, p. 2220 (1789).
Lecanium cymbiformis Targ., Catalog. Coccidarum, p. 37 (1868).
Lecanium berberidis Sign. (non. Schr.[1]) Essais, p. 233 (1873).
Lecanium genistæ Sign., Essais, pp. 235, 484 (1873).
Lecanium persicæ Sign., Essais, p. 237 (1873).
Lecanium rosarum Sign., Essais, p. 257 (1873), (non Sn. v. Voll., 1862).
Lecanium berberidis Mask., N. Z. Trans., XXIX, p. 311 (1897).
Lecanium subaustrale Ckll., The Entom., XXXI, p. 131 (1898).
Lecanium magnoliarum Ckll., Ent. News, IX, p. 146 (1898).
Lecanium magnoliarum var. *hortensiæ* Ckll., Psyche, X, p. 19 (1903).

The genuine *L. persicae* is a large chestnut brown species 5—7 mm. long with 8-segmented antennae as described by Signoret. It is much less convex than *L. corni* and is sometimes rather flattened toward the margins. The 24 to 28 large conspicuous pores in a submarginal row will also aid in identifying this species.

It apparently has been recorded in the United States only from California under the name of *Lec. magnoliarum.*

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[1]*Coccus berberidis* Schrank, Fauna Boica, II, Abt. 1 (1801) is not a Lecanium at all, but the description surely refers to *Mytilaspis pomorum.* "Schinkenmuschelförmig, dunkel rothbraun, weislicht gerandet, am schmälern Ende rostbraun." Freely translated is—Oystershell-shape, dark red brown, pale-margined, rust-brown at the small end. Schrank also refers to the impure white eggs occurring beneath the dead body of the female in April, which is too early for such a record of a Lecanium in a temperate region.

The Frosted Scale

Lecanium pruinosum Coquillett.

Lecanium pruinosum Coq., Ins. Life, III, p. 382 (1891).
Lecanium robiniæ Towns., Bull. 7, N. Mex. Exp. Sta., p. 11 (1892).
Lecanium robiniarum Ckll. (non Dougl.) Can. Ent., XXVII, p. 257 (1895).
Eulecanium robiniæ var. *subsimile* Ckll., The Entom., XXXV, p. 178 (1902).

This species, which has been of some economic importance in California, seems to be a native of the highlands of Mexico, whence it has been introduced to the fruit districts of the above State. The synonymic variety *subsimile,* which occurs on ash or Rhus (?) in Mexico, points to this region as the probable home of *L. pruinosum.* The specific name is descriptive of this species when it is covered with fine powdery wax, but this character is not always evident in some localities where it occurs. Its general appearance is like a very large *L. corni,* very convex, dark reddish brown, variously pitted and grooved; the 7-jointed antennæ and the legs and other characters are quite similar to *corni,* but the derm pores furnish the most evident character for the species, as will be seen by reference to the photomicrograph of the derm. The pores are small, clearly defined, and regularly arranged, but they do not show a tendency to arrange themselves in broken rows perpendicular to the margin as in *L. corni.*

This species occurs in California on the apricot, peach, plum, prune, pear, apple, ash, locust, English walnut, grape, rose, etc. In New Mexico, Arizona and Mexico there may be many other hosts.

The Hickory Lecanium

Lecanium caryæ (Fitch)

Plate 19, Fig. 5

Lecanium caryæ Fitch, 3d Rep. Ins. N. Y., p. 125 (1856).
Lecanium cockerelli Hunter, Kan. Univ. Quar., VIII, p. 70 (1899).
Eulecanium caryæ King, Can. Ent., XXXIV, p. 160 (1902).

Contrary to published reports, Fitch's types of this species are in the national collection at Washington in good condition, so that we know the species accurately. There is little possibility that any one should confuse it with any of our other Lecaniums on account of its enormous size; length, 10–13 mm.; breadth, 7–9 mm., and height, 3–5 mm. The buff or yellowish-brown color of the developing female changes after oviposition to a beautiful deep reddish brown dusted with waxy powder.

This species is a victim of several species of minute hymenopterous

parasites, which usually distort its normal shape and size to a remarkable degree. Many specimens collected in Ohio by the writer from elm, hickory, willow, peach, etc., are so distorted that they would not be recognizable if met with singly. A microscopic examination will surely determine the species, however, if the unusually numerous, large marginal spines are noted, along with the ordinary 6–7 segmented small antennæ.

That *Lecanium cockerelli* Hunter is but a parasitized and distorted form of this species, is the conclusion reached by the writer after collecting and examining many specimens along with Professor Hunter's types. The fact, as reported in the original description, that the tree bearing the types of this form was badly infested, and the following year was almost free from this scale, would suggest almost complete parasitism.

The European Fruit Lecanium

Lecanium corni (Bouché)

Plate 19, Figs. 7, 15

Lecanium corni Bouché, Stett. Ent. Zeit., V, p. 298 (1844).
Lecanium tiliæ Fitch (non Linn.), 4th Rep. Reg. Univ. N. Y., p. 69 (1851).
Lecanium pyri Fitch (in part), Tr. N. Y. St. Agr. Soc., p. 809 (1854).
Lecanium cerasifex Fitch, 3d Rep. Ins. N. Y., p. 50 (1859).
Lecanium ribis Fitch, 3d Rep. Ins. N. Y., p. 109 (1859).
Lecanium cynosbati Fitch, 3d Rep. Ins. N. Y., p. 118 (1859).
Lecanium juglandifex Fitch, 3d Rep. Ins. N. Y., p. 145 (1859).
Lecanium corylifex Fitch, 3d Rep. Ins. N. Y., p. 155 (1859).
Lecanium fitchii Sign., Ann. Soc. Ent. Fr. (5), III, p. 404 (1873).
Lecanium tarsale Sign., Ann. Soc. Ent. Fr. (5), III, p. 430 (1873).
Lecanium armeniacum Craw, Rep. Cal. Bd. Hort., p. 12 (1891).
Lecanium robiniæ Towns., Bull. 7, N. Mex. Exp. Sta., p. 11 (1892).
Lecanium caryæ var. *canadense* Ckll., Can. Ent., XXVII, p. 253 (1895).
Lecanium lintneri Ckll. & Benn., Am. Nat., XXIX, p. 381 (1895).
Lecanium crawii Ehrh., Can. Ent., XXX, p. 245 (1898).
Lecanium caryarum Ckll., Can. Ent., XXX, p. 293 (1898).
Lecanium maclurarum Ckll., Can. Ent., XXX, p. 294 (1898).
Lecanium kingii Ckll., Ann. Mag. N. H. (7), II, p. 322 (1898).
Lecanium kansasense Hunter, Kan. Univ. Quar., VIII, p. 69 (1899).
Lecanium aurantiacum Hunter, Kan. Univ. Quar., IX, p. 107 (1900).
Lecanium websteri King, Can. Ent., XXXIII, p. 106 (1901).
Eulecanium guignardi King, Can. Ent., XXXIII, p. 334 (1901).
Eulecanium rosæ King, Can. Ent., XXXIII, p. 336 (1901).
Lecanium adenostomæ Kuwana, Pr. Cal. Ac. Sci. (3), II, p. 402 (1901).
Eulecanium fraxini King, Can. Ent., XXXIV, p. 158 (1902).
Lecanium obtusum Thro, Bull. 209, Corn Univ. Expt. Sta., p. 212 (1903).
Eulecanium folsomi King, Can. Ent., XXXV, p. 193 (1903).

Besides the above long list of American synonyms, Dr. P. Marchal in his excellent treatise on European scale insects has designated the following European species as synonyms, viz., *vini* Bouché, 1844; *rosarum* Snell v. Voll., 1862; *mori* Sign., 1873; *coryli* Sign., 1873; *rugosum* Sign., 1873; *wistariæ* Sign., 1873; *sarothamni* Dougl., 1891; *assimile* Newst., 1892; *rehi* King, 1901; *persicæ* Newst., 1903; *persicæ* var. *coryli* Newst., 1903; *persicæ* var. *sarothamni* Newst., 1903.

What Muse guided the minds of entomologists while describing this species under its various aliases, the writer scarcely dares conjecture. A certain spell of belief or unbelief, whichever you may choose, must have worked its charm at the psychological moment causing each new lot of specimens from a new locality or food-plant to appear as specifically distinct.

We have also, as bases for new species, exceedingly careful measurements to the thousandth part of a millimeter, of the segments of the antennæ which may be 6-segmented on one side and 7-segmented on the other side of the same scale, or in the case of a parasitized specimen may be 8-segmented or only 5-segmented.

Then again we have what may be designated as "honor" species, since more valid reasons for their existence seem to be lacking, such as *fitchii, lintneri, websteri,* etc. It is well that the integrity and honor of those bearing these names will not be shattered by the downfall of the species dedicated to them.

For several years the writer has carefully added species after species to the synonymy of this exceedingly common Lecanium, only after examining the types or cotypes. The writer has studied the types of all the above names with the exception of four, and in those cases similar topotypic material was seen. Sufficient breeding work in transferring species from tree to tree, with their attendant changes in appearance, was carried out to convince the writer that his observations on the behavior of the cottony maple scale were almost duplicated in this species. Remarkable changes are wrought in the individual scales when transferred to a new host plant.

The synonymy of these species with *L. cerasifex* Fitch has been in hand for some time, but only this year, by means of material from Europe and with the aid of Dr. Paul Marchal's excellent studies on European Lecaniums,[1] has the writer included this entire synonymy under *L. corni* Bouché.

This common species which occurs on so many of our economic and

[1]Notes sur les Cochenilles de l'Europe, Ann. Soc. Ent. France, Vol. LXXVII, pp. 223–309 (1908). Plate and text figures.

wild trees and shrubs, is quite convex in form with irregular, varying rugosities and pits in the hard brown derm of the adult or dead female. Various fuscous transverse and longitudinal markings are evident on the young adult female scale before oviposition in early summer. These markings rapidly disappear at her death and darker brown suffuses the derm, leaving sometimes a trace of fuscous on the dorsum.

The cleared derm appears brownish, antennæ 6 or 7-segmented, usually the latter; legs well developed, ordinary; anal plates heavily chitinized, together forming nearly a square; 6 large and 2 small hairs, on the anal ring; marginal spines rather short and stout 18–24 *mmm.* in length; spiracular spines variable, rather slender, the shorters ones 30–40 *mmm.* and the middle one 50–60 *mmm.* in length. The cleared derm shows extra heavy chitinization of the regions along the anterior margin extending inward toward the antennæ, and also of the posterior lobes near the cleft. The characteristic general arrangement of the many derm pores in very irregular, broken and interrupted radiating rows, is especially noticeable near the margin. In some specimens this character is not so marked.

This species occurs widely in North America on a very great range of mostly deciduous trees and shrubs. In a few instances it has become of economic importance, but not for long on account of its control by natural enemies and parasites. This species determined under various names threatened the plum orchards of New York state a few years ago, and more recently has been occasionally reported from various states of the middle-west as a pest on elm, mulberry, osage-orange and linden.

The range of this species includes practically every state in the Union, and its host-plant list is lengthy; the more important hosts are plum, peach, apricot, pear, currant, blackberry, mulberry, osage-orange, elm, ash, linden, pecan, maple, *Cornus,* etc.

The Oak Lecanium

Lecanium quercifex Fitch

Plate 19, Fig. 9

Lecanium quercifex Fitch, 5th Rep. Ins. N. Y., p. 25 (1859).
Lecanium quercitronis Fitch, 5th Rep. Ins. N. Y., p. 25 (1859).
Lecanium antennatum Sign., Ann. Soc. Ent. Fr. (5), III, p. 413 (1873).
Lecanium pruinosum var. *kermoides* Tyrrell, Rep. Cal. Exp. Sta., p. 256 (1896).

Fitch's two species were described from white and black oak respec-

tively, but the types are identical. This very convex species seems restricted principally to oaks for the writer has attempted several times to transfer it to several other trees but failed to obtain adults, though the larvæ lived for some time on the strange host-plants.

This species is very convex, sometimes broader at the summit than at the point of attachment; light brown with a variable dark marking in the mid-dorsal region. The antennæ and legs are unusually long and slender; the derm pores (see photomicrograph) are rather large and regularly scattered but far apart; the spiracular and marginal spines are more slender than in *corni* or *pruinosum*. This species can be recognized by the three or four apparent scars near the outer angles of the anal plates, which otherwise are quite similar to those of *L. corni.*

The range of this species is very general, but it is of particular economic importance to the oaks in the south Atlantic and Gulf states. Signoret described his species *antennatum* from specimens on oak sent to him by Fitch from New York state.

The Globular Scale

Lecanium prunastri (Fonsc.)

Coccus prunastri Fonsc., An. Soc. Ent. Fr., III, p. 211 (1834).
Lecanium prunastri Sign., An. Soc. Ent. Fr., V, p. 423 (1873).
Lecanium rotundum Sign., An. Soc. Ent. Fr., V, p. 428 (1873).
Eulecanium prunastri Fernald, Catalogue of Coccidæ, p. 193 (1903).

This almost globular, small dark-red species is fairly common in Europe, but is found in few localities in the United States outside of Pennsylvania, where it has been known for a number of years. It infests principally plum, cherry and peach, and is remarkably gregarious in habit.

The best microscopic character of this species is the compound row of 100 or more small derm pores extending anteriorly from the anal plates. A stained specimen shows this character more satisfactorily than an untreated one.

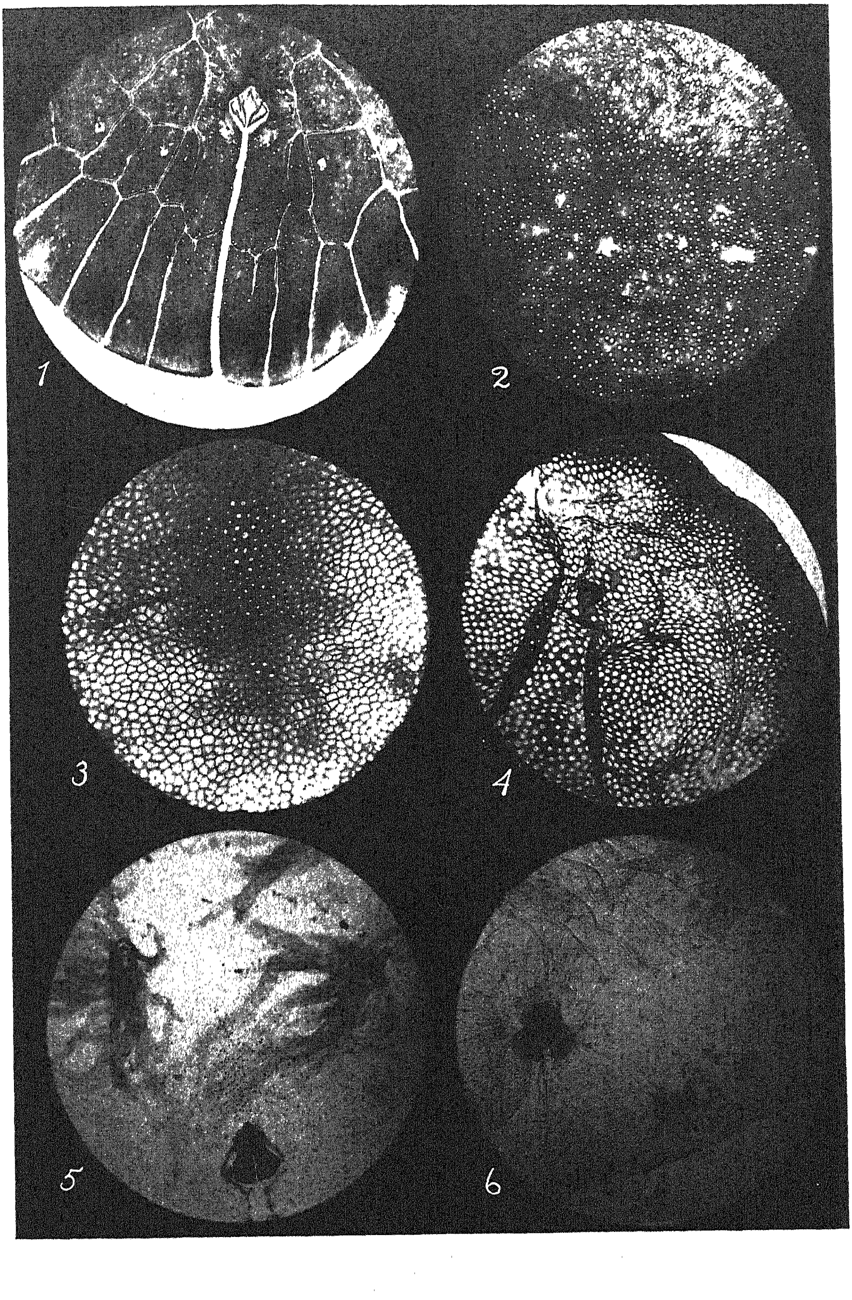
The Terrapin Scale

Lecanium nigrofasciatum (Pergande)

Plate 19, Fig. 6

Lecanium nigrofasciatum Perg., Bul. 18, n. s., Bur. Ent., U. S. Dep. Agr., p. 26 (1898).

The original description of this native scale in the above reference and Circular No. 88, of the U. S. Bureau of Entomology, containing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a popular discussion and a short technical description of the species, are available to most entomologists, so that an extended discussion in this paper is hardly necessary.

Previous to Mr. Pergande's description of this species, it had been for many years confused with *Lecanium persicæ* of Europe, on account of its frequent occurrence on peach trees in this country. At present its general range is limited to the eastern half of the United States, including a few states just west of the Mississippi River. Its food plant list is large and comprehensive, including some of our most important economic and ornamental trees and shrubs.

Its habit of overwintering on the branches of its host plant, in a half-grown stage, is unique among Lecaniums. In microscopical details this species shows relationship with the genus Toumeyella and with Lecanium, and in view of its remarkable life history it may some day require a new genus for its proper reception.

The Tulip Soft Scale

Toumeyella liriodendri (Gmel.)

Plate 19, Fig. 3; Plate 20, Fig. 5

Coccus liriodendri Gmel., Syst. Nat., Ed. XIII, p. 2220 (1789).
Lecanium tulipiferæ Cook, Can. Ent., X, p. 192 (1878).
Lecanium tiliæ Cook, Ent. Amer., I, p. 211 (1885).
Eulecanium tulipiferæ King, Can. Ent., XXXIV, p. 60 (1902).
Eulecanium liriodendri Fernald, Cat. Coccidæ, p. 190 (1903).

A tree badly infested with this species presents a more disgusting appearance than any other of our common soft scales. Although quite confined to *Liriodendron tulipifera* as a host plant, it occasionally is found on Magnolias, but is easily distinguished from the larger, flatter magnolia soft scale by its very convex irregular form and dull clay-yellow color.

This species has been erroneously classified in Eulecanium. The character of its antennæ and legs which are reduced to mere stubs preclude any relationship with *Lecanium persicæ*, *L. prunastri*, etc., but instead relegates it to the genus Toumeyella, with which group it has derm characters in common.

This species was first described in Europe as *C. liriodendri* from Liriodendron trees imported from America, then about a hundred years later was described in America under the name *tulipiferæ*. During these years these two names have been held as representing distinct species, and more recently have been placed under the subdivision Eulecanium where they have no relationship.

The Magnolia Soft Scale

Neolecanium cornuparvum (Thro.)

Plate 19, Fig. 13; Plate 20, Fig. 6

Lecanium cornuparvum Thro, Bul. 209, Cornell Exp. Sta., p. 216 (1903).

This large flat scale has been erroneously determined and discussed by a few writers under the name *L. magnoliarum*, and has existed scientifically undescribed until 1903, although not an uncommon insect. It occurs on various species of Magnolias, including the deciduous *M. acuminata* of the Northern States. The pink color of the growing female scale is somewhat hidden by the covering of fine powdered wax, which also fills the spiracular grooves on the ventral surface and remains as four distinct white lines after the removal of the scale from its host.

The adult females average 8—10 mm. long and 5—8 mm. broad. When cleared and mounted the derm is seen to be crowded with large pores, and the very short reduced antennae and legs are scarcely noticeable.

It has been reported from New York, Ohio, Pennsylvania, Maryland, Virginia and Louisiana.

A NEW ENEMY OF THE FLORIDA ORANGE

By E. A. Back, *Orlando, Fla.*

The purpose of this notice is merely to call the attention of Entomologists to the discovery for the first time in this country of another pest of the citrus tree. In view of the widespread havoc played among the orange groves of Florida by the Citrus white fly, *A. citri* Riley and Howard, and the Spotted-wing, *A. nubifera* Berger, the discovery of another Aleyrodid which already has demonstrated itself to be of economic importance is interesting.

While recently examining orange trees along several streets in the business section of Tampa in connection with the white fly investigations being carried on in Florida by the Bureau of Entomology, the attention of the writer was attracted to dense white or grayish woolly secretions concealing the under surfaces of many leaves. At first this was supposed to be a heavy infestation of the usually scarce *Paraleyrodes perseæ* Quaintance, but on closer examination proved to be *Aleyrodes howardi* Quaintance, which until the present time has been known only to infest the orange trees of the West Indian Islands. In

Cuba it was first noted in 1903 by Mr. E. A. Schwarz, at Havana; and later, in 1905, by Mr. C. L. Marlatt at Artamisa, and at Santiago de las Vegas by Dr. Mel T. Cook.

Very little is known of the capacity for injury possessed by this Aleyrodid. Mr. C. L. Marlatt found it quite abundant locally on several of the old orange trees at Artamisa, but at that time, 1905, noted that it had spread but slightly into the surrounding younger groves. When describing it for the first time, Mr. A. L. Quaintance stated that judging from its abundance on leaves sent the Bureau of Entomology from Cuba it was a very serious pest of the Cuban orange, perhaps rivaling the Citrus white-fly of Florida. Whatever damage it is causing in Cuba, where it may be partially controlled by parasitic and predaceous enemies, it has shown itself capable of rapid multiplication and spread in its new home at Tampa. Notwithstanding the fact that it has not been observed in Florida before, although the same trees upon which it is now so abundant were casually examined by the writer in 1907 and 1908, it has become well established over a very large portion of the city, spreading northward beyond Michigan Avenue and eastward into Ybor City. Trees across the Hillsboro River, on the grounds of the Tampa Bay Hotel, are well infested, hence it is safe to presume that the pest is well established in the western part of the city.

From the present infestation it is quite apparent that the insect first became established near the water front. In this section neglected worthless trees along the streets and in door yards are in many cases very heavily infested. While it appears to be rivaling the Citrus white-fly in the extent of its attack on some trees, it is improbable that it is capable of causing so widespread disaster to citrus trees. Yet if it once becomes abundant in a grove, it will prove a source of no little aggravation and discomfort to those working in the trees because of the large and extremely vicid drops of honey dew which collect over the bodies of the insects, and later become embedded in the copious waxen secretions.

A more technical paper, with descriptions and drawings, is being prepared for early publication as part of the series of technical bulletins being issued by the Bureau of Entomology.

NOTES ON THE PARASITES OF THE SATURNIIDAE[1]

By W. F. Fiske and W. R. Thompson.

The main object under way at the Gypsy Moth Parasite Laboratory at Melrose Highlands, Mass., as is generally well known, is the importation and colonization of the parasites and predatory insect enemies of the gypsy moth and the brown-tail moth. Studies of the biology and habits of the various parasites and predators have been undertaken whenever opportunity permitted or necessity demanded, and in addition, when it could be done without prejudice to more important work, occasional studies have been made of the parasites of native insects. The result has been the accumulation of a quantity of notes upon the general subject of parasitism in its relation to the natural control of insects, and upon the biology and inter-relations of the parasites themselves. The knowledge thus gained has been of considerable practical assistance in the prosecution of the work on numerous occasions.

It has been the rule to select as subjects for such minor investigations those insects which most closely approached the gypsy moth in habit or in their natural affinities. American representatives of the family Liparidæ, whenever they could be secured in sufficient numbers to make the results representative of the conditions, have received particular attention, while the fall web worm, tent caterpillars, etc., have come in for a lesser share. The native silk worms, on account of their dissimilarity to the gypsy moth were not considered as subjects for such a study until the publication of Dr. Smith's paper on the parasites found in *cecropia* cocoons in the Journal of Economic Entomology for October, 1908, suggested it.

Credit for its inception is due to Mr. C. H. T. Townsend, at that time associated with the laboratory, who desired particularly to secure additional data upon the Tachinid parasites of those hosts, and upon their hibernating habits. In the preparation of the notes for publication the junior author undertook the compilation of the statistical data on percentage of parasitism in various localities, etc., and also completed the study of the Tachinid parasites which was begun by Mr. Townsend before he severed his connection with the laboratory to accept a position with the Peruvian government. For the collection of material the authors are wholly indebted to the officials and fieldmen associated with the work against the gypsy moth and brown-tail

[1]Occasional Contributions from the Gypsy Moth Parasite Laboratory, I. Published with the approval of Dr. L. O. Howard, Entomologist, U. S. Department of Agriculture.

moth in Massachusetts, and to the agents and employees of the Bureau of Entomology, similarly employed in Massachusetts and New Hampshire.

Although exact comparisons are, of course, impossible, there is little doubt that *cecropia* is very much less common in southeastern New England than it was in those sections of Long Island and New Jersey from which Dr. Smith secured his material. The collection in eastern Massachusetts or southern New Hampshire of as many as 1,000 cocoons would have been an almost herculean task. The total number of cocoons received from a considerable number of men regularly engaged in field work, who were instructed to collect and forward to the laboratory any that they might find, was only 370, without counting those a year or more old. In addition there were 997 cocoons of *promethea* and 40 of *polyphemus*.

Material was received from a large number of towns, scattered over a territory of considerable extent. A few more from the shores of Buzzard's Bay, many from the more central sections of the state east of Worcester, but the larger number from the northeastern towns, along the shore and in the lower valley of the Merrimac. The New Hampshire material was nearly all from the valleys of the Merrimack and Suncook rivers.

Comparison between the cocoons of *cecropia* received from these various localities and those studied by Dr. Smith as regards the prevalence of parasitism, death through other causes, etc., is interesting, and is as follows:

	New Jersey and Long Island		Mass. and New Hampshire	
	Number	Per cent	Number	Per cent
With healthy pupæ	36	3.5	151	41
Dead but not parasitized	697	68.	96	26
Parasitized	295	28.5	123	33
Total	1,028	100	370	100

It will be noted that the percentage of parasitism in the two lots is not particularly different, but that the proportion of healthy pupæ in Massachusetts and New Hampshire is very strikingly larger. This is, apparently, a confirmation of Dr. Smith's conclusions concerning the relative effectiveness of parasites versus other causes in the control of this insect, and would seem to support the theory that the parasites were less mobile, and therefore less active agents in natural control. A comparison between the condition existing in Massachusetts and New Hampshire, respectively, in the winter of 1908–1909 does not support this contention, however, as may be seen by the following:

	Massachusetts		New Hampshire	
	Number	Per cent	Number	Per cent
With healthy pupæ	132	45.8	19	23.2
Dead but not parasitized	74	25.7	22	26.8
Parasitized	82	28.5	41	50.
Total	288	100	82	100

In this comparison it will be noted that the percentage of dead from other causes than parasitism remains almost exactly constant, while that of parasitism is more than three fourths greater in New Hampshire, or almost twice as large. It would have been better had the number of cocoons from New Hampshire been larger, since it would have lessened the chances for error, but the relative condition of the *promethea* cocoons, similarly compared, as will be seen by the following tends to substantiate the results with *cecropia:*

	Massachusetts		New Hampshire	
	Number	Per cent	Number	Per cent
With healthy pupæ	254	41	46	15
Dead but not parasitized	137	22	70	23
Parasitized	231	37	192	62
Total	662	100	308	100

The number of cocoons thus classified falls a little short of the 997 which was mentioned as the total number studied, as there were a few of somewhat doubtful origin. The greater proportionate destruction by parasites in New Hampshire is quite as strikingly brought out in this comparison as in the other, and it is worthy of note that the parasitism of *promethea* was uniformly higher than of *cecropia* under all conditions, and the death through causes other than parasitism lower.

An attempt was made to determine whether the percentage was uniformly higher or lower than the average in restricted regions, as, for example, in the lower Merrimac Valley or along the "North Shore" in Massachusetts. The results were all negative, and instead of supporting the proposition tended strongly to indicate that immediate local conditions had very much to do with the matter. Enormous variations in parasitism were found in different lots from the same town or from towns closely adjacent, and the only conclusions which could be drawn from the considerable series of careful computations which were made are that the *average* percentage of parasitism was greater to the north than to the south, although there were frequent exceptions to the rule. The futility of attempting to draw general conclusions from a study of material from one locality seemed to be well demonstrated, and it is likely that this will apply equally well to other insects than those studied.

The Primary Parasites

The list of primary parasites which were reared or otherwise secured from the several hosts is included in the following table, together with the numbers, gross and proportionate from each:

	Promethea		Cecropia		Polyphemus	
	Number	Per cent	Number	Per cent	Number	Per cent
Ophion macrurum	326	32.7	27	7.3	4	10
Spilocryptus extremis	109	10.9	4	1.1	1	2.5
Theronia fulvescens	4	.4				
Diglochis omnivorous			2	.5		
Tachina (?) sp.	5	.5	46	12.4	1	2.5
Achætoneura frenchii			44	11.9		
Total	444	44.5	123	33.2	6	15.

The most surprising feature of this list is the very considerable percentage of parasitism of *cecropia* by Tachinid flies, amounting to nearly three times the total parasitism by Hymenoptera. There are at least two species, the larvæ of one of which pierce the cocoon of the host and drop to the ground for pupation, leaving as characteristic evidence of their occupancy the exit hole in the cocoon, the first and second stage moult skins within the host remains, and frequently, but by no means always a few dead maggots which were too weak to accompany their healthier companions. None of these signs are conspicuous, and all might be overlooked in a casual study of the cocoons, and it is easily possible that a portion of those studied by Dr. Smith may have been parasitized by the same or another species with similar habits.

No adults of any species having this habit were reared. An examination of the larvæ which were left behind makes it probable that they were all of one species, and possibly that they are to be referred to the genus Tachina, as they possess very many of the characters of *Tachina mella* Walk.

The other species which is about equally abundant pupates within the cocoons, and has been determined as *Achaetoneura frenchii* W. Not all of the puparia hatched, but from the 44 cocoons a total of 550 flies, an average of between 12 and 13 from each, were reared. If it had been present in the New Jersey or Long Island material it would most certainly have been observed, and its absence is worthy of comment.

The average number of flies issuing from one cocoon is no indication of the number which may sometimes mature on one host. In one instance Mr. Townsend counted no less than 90 puparia from which the flies had emerged and in another he found and counted

exactly 147 dead maggots in a single *cecropia* caterpillar. This last is a particularly interesting instance of the disastrous results which frequently follow double parasitism of an individual host by the same species of parasite, the 147 maggots probably representing the progeny of several females.

They were sufficient, had they been distributed judiciously, to have parasitized successfully at least 8 caterpillars. Concerted attack upon a single individual resulted in the death of all and illustrate in a striking manner the consequences which follow too rapid increase of any parasite in proportion to the increase of the host. Even in the other instance mentioned, in which 90 flies completed their transformations, the puparia were so small as to make it certain that the flies were undersized, and presumably, since it holds with Hymenopterous parasites under similar circumstances, proportionately weak.

As may be seen by reference to the tables, the Ophion was the most common of the Hymenopterous parasites outranking all of the other species taken together. As in Long Island and New Jersey, the apparently specific disease which attacks the larvæ sometime after they have spun their cocoons and before the discharge of the meconium, and which is characterized by the reduction of the body into a mass of semi-liquid filth, was extremely prevalent. As Dr. Smith truly says, the condition is by no means unusual, and the continued existence of the species in spite of the adverse conditions is rather remarkable, if, as seems probable they are the rule rather than the exception. The struggle for existence is further accentuated by the habit of oviposition in young or only partly grown caterpillars. The first stage larvæ have been found upon several occasions in caterpillars which were not nearly half grown, and if this is habitual, as it probably is, the parasite is subject to all of the vicissitudes which beset its host during the later larval period.

Dr. Smith records an emergence of something like 25 per cent, which is very far in excess of the number completing their transformations in Massachusetts and New Hampshire, as indicated by the collections of cocoons. Out of the 350, only two adults were secured, or less than 1 per cent of the total. Death was not due in every instance to the disease, secondary parasitism being fairly frequent, but the total thus destroyed could not have amounted to 10 per cent. It is possible that the species is frequently parasitic upon some other host better suited to its needs than is *cecropia* or *promethea.*

Spilocryptus was generally healthy, and emergence probably amounted to at least 90 per cent of the total except in instances

when the cocoons were injured or used for experimental purposes. Secondary parasitism was of fairly frequent occurrence, but probably amounted to less than 5 per cent.

The new light which was thrown upon that most remarkable parasite, *Theronia fulvescens* as a result of these investigations was in itself almost sufficient to justify the undertaking. The species has variously been recorded as primary and secondary in its relations with different hosts, and the apparently incontrovertible evidence which has been adduced in support of both contentions has been, to say the least, very perplexing. It is of particular interest, since it is the most common parasite of the gypsy moth native to America, and in nearly every instance it appears to be primary in its relations to this host. *Theronia atalantæ,* in Europe, and other closely allied and possibly identical species in Japan are indistinguishable in their early stages, and while they are relatively insignificant parasites of the gypsy moth in their respective countries, they are about as common as *T. fulvescens* in that connection.

So far as known the adults always hibernate, and in consequence no living larvæ or pupæ were found in any of the cocoons which were opened. There were twenty cocoons which contained dead adults or pupæ, or from which the adults had escaped leaving their characteristic, rudimentary cocoons of dark brown silk as certain indication of their former presence. Twelve contained dead, fully formed adults, which had been unable to escape through the dense silken walls. Two contained dead pupæ, and from six only had the adults emerged successfully. It is obvious that the host is not particularly well adapted to the parasite when above 50 per cent are unable to effect their escape after completing all of their transformations, but the phenomenon presented is not out of keeping with other, somewhat similar observations which have been made, and which go to show that the discretionary powers possessed by the parent females of parasites generally are decidedly limited.

In four out of the twenty instances, Theronia was apparently primary, and there seems not to be the slightest doubt that it was so in one instance in which the dissection of the host remains, for the purpose of discovering traces of any other parasite which might have been present, was so thorough as to result in finding all three larval moult skins as well as the pupal exuvium. In three out of the four it was internal in the *promethea* pupa, in the other it appeared to have fed externally upon the caterpillar prior to pupation.

In a single instance a dead Theronia, in the form of a fully colored

pupa was found within the cocoon of Spilocryptus, upon the larva of which it had fed, and in the remaining fifteen it was apparently a secondary upon Ophion. It may have been truly what it seemed, that is hyperparasitic, or it may have been that its occurrence in this rôle was purely accidental, and that in oviposition the female selected the cocoons irrespective of the character of their contents. Most frequently the Ophion larva was overcome before it had completed its cocoon, but in several instances the Theronia escaped, or attempted to escape through the perfectly formed cocoon. The preponderance of the instances in which Theronia appeared to be secondary is quite what would be expected, owing to the longer period during which Ophion would be open to attack. It is believed that after the *promethea* has pupated, and the pupa is hardened, that it is immune, and that oviposition can only be successful when the prepupal caterpillar or perfectly fresh pupa is selected. Ophion, on the contrary, since it hibernates as a larva, is open to attack at any time during the fall.

Only two of the pupæ of *cecropia,* and none of the other hosts were attacked by Diglochis, and in both instances, while the number of larvæ of the parasite was sufficient to kill the host, there were not enough nearly to consume it. As a consequence the larvæ and pupæ, surrounded by the unconsumed and decomposing matter, nearly all died. A very few adults which were reared oviposited with great freedom upon the pupæ of *promethea* to which they were given access. It is certain that they would attack this host as well as *cecropia* in the open, were it not for the protection afforded by the cocoons.

Inter-Relations of the Primary Parasites

A considerable amount of evidence has accumulated during the past three summers at the laboratory which tends strongly to support the contention that the prescience of the female parasite is insufficient to enable her to distinguish between parasatized and unparasitized hosts for her progeny. If this be a fact, the result must be that an individual host is frequently attacked by two different species of parasites, or as has been presupposed in the instance of the 147 Tachnia maggots already mentioned, by the same species more than once. Instances of double parasitism are, in fact, of frequent occurrence, and a study of the results in specific instances are often very interesting. Several rather novel examples were encountered in the present study.

The apparent secondary parasitism of Ophion by Theronia is

believed to be an instance of this sort, and so far as known the former is always the victim in such a conflict. The same is true of Spilocryptus, undoubtedy a primary parasite and to be considered as such. In several instances in which it was found in the same cocoon as Ophion, it destroyed the larva, feeding upon it as an external parasite, exactly as it would have done upon the caterpillar had it remained alive. In one instance the cocoons were found massed within that of the Ophion, but usually the Ophion cocoon was incomplete or entirely lacking. In one instance no less than 10 healthy larvæ reached maturity; usually they were less, and sometimes only a few, or none at all completed their development. The most interesting examples were found in old cocoons, from which all the living parasites had escaped.

The outcome of double parasitism by Spilocryptus and Theronia depends upon which is the first in the field. It is very probable but unproven that the young, internal feeding Theronia is destroyed by the external feeding Spilocryptus through deprivation of its food supply. In one very extraordinary instance the Theronia reached full development as an internal, and the other as an external parasite, a state of affairs never before met with. In another, in which the Spilocryptus was obviously the first to attack, a dead Theronia was found in one of the several cocoons of the other.

A study of the host remains in cocoons which had been attacked by any of the parasites would probably result in the discovery of evidences of attack by other species which had been destroyed in such an early stage in their development as to leave no conspicuous remains. Spilocryptus, for example, is undoubtedly the victor in some instances in which it conflicts with the Tachinid parasites. In others it is likely to die as a result of the premature death of the host. Ophion invariably kills its host before pupation, and the Tachinids frequently, though not always afterward. There is a possibility, since it is the first to mature, that occasionally it triumphs over them, but this is not always the case. In two most remarkable instances, it was, as usual, the victim.

In each of these the Ophion cocoon, normal in appearance and texture, was found in its usual situation within cocoon of *cecropia,* and the walls of both were pierced by the characteristic exit hole of the Tachinid maggots. The Ophion cocoon was empty, except for the skin of the larva, and in spite of the almost conclusive evidence that Tachinid maggots had somehow gained entrance and destroyed the occupant, the circumstances were so remarkable, and altogether out

of keeping with the ordinary, as to demand additional substantiation. Careful examination of the contents of one of these parasite cocoons discovered nothing (the other was unfortunately lost) but when the remains of the primary host were examined a quantity of second stage Tachinid moult skins, and one dead and dried Tachinid maggot were found. It seemed to prove conclusively that the maggots, threatened with starvation through the more rapid development of their common rival, had migrated into its body, and there continued their development exactly as they would have done had they remained in undisputed possession of their original host. Additional color is given to this conclusion by another instance involving the parasites of an entirely different host, in which the young larva of one is known, beyond peradventure of doubt, to have entered in a similar manner the body of a rival.

The Secondary Parasites

Nothing approaching the tremendous percentage of hyperparasitism recorded by Dr. Smith was encountered in the course of this study. Dibrachys, of which he reared scores of thousands, is a very common hyperparasite throughout southern New England, but was very rare in this connection. One mass of Spilocryptus cocoons a year or more old was found to have been infested, and a few dead pupæ and adults found. A very few were also reared from a few masses of the Spilocryptus cocoons which had been torn from their original position in the cocoons of their hosts, and placed together in a small cage. These immediately oviposited in the still dormant larvæ of the primary parasite, and a very much larger number of the second generation were reared.

Even when Spilocryptus was collected in mid-winter and exposed to continuous high temperature until spring it did not complete its transformations until after the press of regular spring work had made further observations impracticable, and the date of its usual emergence in the open is not known. It is very likely not until well into June in this latitude, and Dibrachys which only requires one month of average late spring temperature in which to complete its life cycle has ample opportunity to complete one generation and probably two before its host resumes activity. Unlike that species, it responds almost immediately to "forcing" during the winter, so that no time is wasted in making a start. It is likely, too, that only in somewhat exceptional instances is it able to reach the well protected cocoons of the Spilocryptus, since it has not been known to gnaw its way through

any obstacle for the purpose of oviposition. There is reason to suspect, therefore, that Dr. Smith unwittingly supplied a comparatively few females which were actually reared from his material with conditions peculiarly suitable for their rapid reproduction, with the extraordinary results which he chronicles.

Bathythrix pimplae, originally described by Dr. Howard from a few specimens reared by him from cocoon masses of the tussock moth, and considered to be a parasite of *Pimpla inquisitor,* was reared in rather small numbers in the aggregate from the cocoons of Spilocryptus. Usually only one or two cocoons in each mass were attacked, and two or three of the secondary usually came from each individual host cocoon. Like Dibrachys, Bathythrix responds almost immediately to forcing, and the females are able to oviposit for two generations in the sluggish larvæ of the Spilocryptus. It is very probable that there is at least one full generation in the spring, and possibly two or more.

Hemiteles perilili Ashm. was occasionally encountered as a parasite of Spilocryptus, and in one very remarkable instance, of Ophion. No living specimens were secured, and since it was difficult positively to distinguish its cocoon exuviæ, etc., from those of Bathythrix, its identity could only be established through the occasional dead adults found. The occurrence of a dead adult within the cocoon of Ophion established this record indisputably, and it is indeed remarkable that a species which can successfully mature within the cocoon of a minute Apanteles can also attack a host at least one hundred times larger than itself.

An undetermined species of Pimpla was reared in very small numbers from the old cocoon masses of Spilocryptus, within which it had apparently passed a considerable portion of the previous summer. It was thought possible that the record was based on error, and that the actual host was some other insect which had sought the shelter afforded, but later another individual was reared from a cocoon of Ophion, and its identity as a secondary parasite associated with *promethea* was definitely established.

Another secondary parasite, not yet determined, but belonging to the exceedingly remarkable genus Perilampus, was reared from the puparia of *Achaetoneura,* from the cocoons of *cecropia.*

Spilochalcis, which was reared by Dr. Smith in some numbers appears to be a rather uncommon insect in southeastern New England, and no surprise was felt in not encountering it at all in this work.

Conclusions

It was hoped to supplement the winter work on the cocoons of these moths with a study of the parasites which attack the immature caterpillars and eggs during the summer, but it was found to be wholly impracticable. Egg parasites are known to exist, and probably those which will attack one species will breed with equal freedom in all. In several instances the eggs of *promethea,* which are somewhat easier to find than those of the others, owing to their being deposited in some numbers together, have been found with exit holes of some parasite. It is quite possible that parasitism of the eggs is at times a considerable factor in the control of the host.

The parasites of the young caterpillars are hardly better known. There is one which is related to Apanteles which issues from the first and second stage caterpillars of *luna* and *polyphemus* and possibly attacks the others also, but the cocoons have usually been hatched, or have been attacked by secondaries when discovered. It appears to be rather abundant. A Limnerium attacks the caterpillars of *promethea* before they are half grown and may attack the others also, but no attempt has been made to collect and rear it.

Altogether it would appear from the very limited observations which have been made, that the parasites of the immature caterpillars outrank in importance those which attack the larger caterpillars and pupæ, but until more is known concerning them, and the part which they play in the control of their common or respective hosts, it is impossible to draw any conclusions as to their relative effectiveness.

The percentage of parasitism indicated by the study of the cocoons was greater than was expected, and it is believed that the extraordinary variation in the percentage thus destroyed in different localities is indicative of the importance of this group of parasites as a factor in natural control.

PROGRESS OF THE NATIONAL INSECTICIDE BILL

At the last session of the Association of Economic Entomologists the committee on insecticides reported that a bill for the federal control of the purity of insecticides had been introduced into Congress and had the support of the leading manufacturers[1].

The measure introduced into Congress was originally suggested by the insecticide committee of the Association of Economic Entomologists which called a conference of manufacturers, entomologists and agricultural chemists which met at New York, June 18, 1908. This conference appointed an executive committee to represent it in pushing the passage of the bill as amended by the conference before Congress. This committee consists of the following:—E. D. Sanderson, Chairman, and H. E. Summers, representing the Entomologists; J. P. Street, Chemist, Conn. Agricultural Experiment Station, representing the agricultural chemists, and H. F. Baker, Pres. Thomsen Chemical Co., Baltimore, Md., and R. G. Harris of the Grasselli Chemical Co., Cleveland, Ohio, representing the manufacturers. The committee has recently sent out the following report of progress to all parties interested:

The committee met at New York, July 23, 1908, organized, and appointed an advisory member in each state to secure support for the bill. The bill as amended was at once printed and given general circulation among agricultural and horticultural organizations and the agricultural press. The committee met at Washington, D. C., November 16, 1908. Methods of introducing the bill in Congress were discussed and tentative plans therefore were made. Objections having been made to the standard for arsenate of lead as defined in Sec. 6, of the bill, a meeting was held at the Hotel Belmont, New York, December 8, 1908, to which all the manufacturers were invited to consider the same, and this section was finally unanimously amended to read as found upon the bill, favorably reported by the Senate Committee on Agriculture and Forestry. Messrs. Baker and Sanderson were appointed by the committee to visit Washington when necessary to aid in the passage of the bill and to call a meeting of the whole committee whenever a hearing before Congressional Committees could be secured. They visited Washington, January 14 and February 4, 1909, and with others called upon the gentlemen who had introduced the bill and the members of the committee to

[1]See Journal Economic Entomology, Vol. 2, page 224.

whom it had been referred. On the latter date, it was found that the bill had been favorably reported to the Senate, but conference with influential members of the House Committee on Interstate Commerce, to which the bill had been referred, showed that it would be useless to attempt to secure a hearing or push the bill in the House during the short session. Owing to the pressure of business during the last month, the bill did not come to a vote in the Senate.

During the recent special session the bill was again introduced in the House by the Hon. E. A. Hayes, of California—H. R. 2218.

The agricultural and horticultural interests of the country supported the bill before Congress most loyally. Practically all the leading agricultural and horticultural organizations have heartily endorsed the measure and the agricultural press has given it cordial support. Your committee believes that with united effort the bill can be made law at the coming session of Congress and asks your continued support to the end.

On November 18 the committee held a conference of all the leading manufacturers, practically all of whom were represented, who again unanimously supported the bill with one or two minor amendments. There can be no doubt that the leading manufacturers are heartily in favor of the passage of this legislation. Its adoption by Congress will depend almost entirely upon the demand made for it by the horticultural and agricultural interests of the country. The Association of Economic Entomologists has already endorsed this measure and it has been endorsed by all the leading agricultural organizations of the country. The entomological representatives on the committee would therefore urge that the entomologists use their best influence with their constituents toward calling the matter to the favorable attention of Congress. A hearing before the House Committee on Interstate Commerce will be secured at the earliest possible moment in December and we hope to be able to report further progress at the meeting of the Association in Boston.

E. D. SANDERSON.

NOTES ON TWO INSECTS FOUND ON CORN

By R. L. Webster, *Ames, Iowa*

In some notes made during last year, 1908, I find that two insects are mentioned as being found on corn, the occurrence of which I have been unable to find any other record. Since the two species are not mentioned in the 18th or 23d reports of the Illinois State Entomologist (Forbes Corn Insects) it may be worth while to record the following data:

Hemerocampa leucostigma S. & A. A nearly mature larva of the whitemarked tussock moth was found on a corn leaf in a field of corn near the college on August 31st. The leaf was partly eaten when found, and the larva continued to feed on it after taken to the insectary. The larva completed its transformations and a female moth emerged September 21st.

Aphis setariæ Thos. On July 1st a winged form of this species was found on a corn blade in a field near Ames. The aphid had produced several young, all of which were brought to the insectary and placed on a corn plant. These, however, died within a few days.

On July 7th I found both winged and wingless adult forms on blades of corn, of which two the winged form had several young beside it. These specimens were placed upon corn in the insectary. On the same day Mr. C. E. Bartholomew brought in winged and wingless forms of *Aphis setariæ* Thomas, which were at that time very common upon plum. A comparison between the aphids on the corn and those on the plum showed them to be the same.

In the insectary these aphids failed to live upon corn for any length of time. In the field they were found but sparingly, and always with very few young in the colonies. The fact that apterous adults were found on corn indicates that the species is able to live upon that plant long enough to attain maturity. Later in the season *Aphis setariæ* was found common on *Setaria glauca* and *Panicum crus-galli*, as well as upon plum, in the vicinity of Ames.

Diabrotica longicornis Say. While on a field trip in the northern part of the state in September this year I spent some time looking for the beetles of the northern corn root-worm, which is practically unknown in that part of the state. After an hour's search in a cornfield in northern Kussoth County, Iowa, I found a single adult within a quarter of a mile of the Minnesota line. I believe that the species has not been recorded in Minnesota.

Discussion and Correspondence

The following communication has been received from Mr. Nathan Banks:

I do not know as it is of any use to say much about Dr. Nuttall's statements on page 361, JOURNAL OF ECONOMIC ENTOMOLOGY, 1909. Anyone who uses the work can see readily how largely it is a compilation and not a monograph. Dr. Nuttall says that of the eleven valid species of Ornithodoros they have studied eight. Of the three valid species that they do not know, specimens of two are in the Paris Museum, and the type of the other is in Berlin; all were studied by Dr. Neumann. Moreover there are three "doubtful" species, the type of one is in Berlin, and Dönitz states it has a good structural character. The two other doubtful species were described by Birula (St. Petersburg). Dr. Birula is alive and available, and in a similar case where the present writer was in doubt about one of Dr. Birula's species (*Ixodes signatus*) he wrote to that gentleman and obtained a cotype of the species.

Besides the five species of Argas seen by Dr. Nuttall there are two species described by Dr. Neumann, the type of one in Paris, the other in Berlin, while another species, classed "doubtful" by Dr. Nuttall, has been identified by Dr. Neumann from numerous specimens in the Paris Museum. To receive some material from a museum, and to go to that museum and study the type-material are very different matters. After the description of *O. turicata* we read, p. 59. "Neumann's description from which the above is partly taken," etc.

After the description of *O. talaje* we read, p. 60. "The foregoing description (condensed from Neumann, 1896, p. 34-36) is based on the examination," etc.

After the description of *O. erraticus* we read, p. 64. "Neumann's description, from which the above is taken," etc.

After the description of *O. thalozani* we read, p. 66. "The above description of the adult and nymph are condensed from Neumann," etc.

After the description of *O. megnini* we read, p. 75. "The foregoing description of the adult is partly based on that of Neumann," . . . "that of the nymph on the description of Neumann and Salmon and Stiles."

Is this the way to prepare a monograph? A monograph represents original work, largely on type material; a going behind the descriptions of others, not a compilation from them; an examination of the

material upon which other descriptions were based, verifying synonymies, etc.

I have not stated nor implied that Dr. Nuttall did not give sufficient credit. One has only to consider that 12 of his 45 original figures refer to one species, and seven others to another species to see how largely he has depended upon others, for illustration,—Nathan Banks.

THE ROSE CURCULIO (RHYNCHITES BICOLOR FAB.) IN MASSACHUSETTS[1]

By BURTON N. GATES, PH. D., *Bureau of Entomology, Washington, D. C.*

During the spring of 1909, while at Clark University at Worcester, Mass., I had an opportunity to make certain observations on this insect which it is hoped will draw attention to its presence in injurious numbers and lead to a more thorough knowledge of this species.

In Massachusetts the rugosa or Japanese rose is usually quite exempt from insect attacks. During the present summer (1909), however, apis species and the rose-cuculio (*Rhynchites bicolor* Fab.) became common upon it. It was the prevalence of this beetle which especially attracted the writer's attention.

The cuculio was first noticed late in May, and in June became more numerous. By thrusting their snouts into the swelling rosebuds the adults ruined practically every bloom in the vicinity of Worcester. Some blossom clusters had as many as twelve or fifteen beetles on them. Shortly after attacking the Japanese roses they appeared on the hardy perennial varieties, at the time when they commenced to show color. A week later the writer found the beetles on the wild roses in the fields of North Grafton. July 10, when leaving Massachusetts for Washington, Rhynchites were still numerous and active.

The unusual damage to roses this past summer was noticed by most growers, but was attributed to the common rose-chafer (*Macrodactylus subspinosus* Fab.[2]). Few persons, until their attention was called to Rhynchites, had noticed the invasion of the cuculio.

The writer attempted hand-picking the beetles, but found that this method made little impression, as large numbers flew in from neighboring gardens. Furthermore, the behavior of the species, the habit of feigning death and dropping to the ground, made it impossible to gather all the beetles from a bush. Also, the prevalence of the cuculio on wild roses precludes eradication or check by hand-picking. Consequently, it would appear that bio-

[1] The occurrence of this insect in two other localities not listed in Bulletin No. 27 of the Bureau of Entomology, referred to below, has been called to the author's attention. In Maryland, specimens were captured in August, 1898, at Boonesboro, Washington County (Western Maryland), and are preserved in the collection of the Maryland Agricultural Experiment Station. Mr. A. B. Gahan of this station says the species is common around Manhattan, Kan.

[2] Chittenden, F. H. The rose-chafer *Macrodactylus subspinosus* Fab. Bureau Entomology, Circular No. 11. Revised, July 16, 1909. 4 pp. Illus.

logical forces, such as enemies, diseases and meteorological conditions, must be relied upon to check or control this pest.

The feeding of Rhynchites was not confined to the rose flowers or buds, but extended even to clusters of tender, unfolding leaves, which became badly mutilated.

Several pairs of insects were seen mating. Although a special effort was made to observe egg-laying none were seen in the act.

A summary of observations on this insect may be found in Bulletin No. 27 of the Bureau of Entomology by F. H. Chittenden.[3] Specimens have been taken, according to Mr. Chittenden, in various places from the Pacific to the Atlantic, but no outbreak in Massachusetts is recorded. While this year may not be the first appearance of this insect in Massachusetts, it is the first time the damage has been general and noticeable in the central part of the state. Close watch will be kept for its re-occurrence in succeeding years.

NOTES ON HONEY BEES GATHERING HONEY-DEW FROM A SCALE INSECT, PHYSOKERMES PICEAE, SCHR.

BURTON N. GATES, PH. D., *Bureau of Entomology, Washington, D. C.*

It is known that scale insects as well as aphids secrete honey-dew. For instance, *Lecanium oleæ*,[1] upon the citrus fruits of California produce great quantities of honey-dew, which collects as a coating upon the leaves and is a medium for the growth of a fungus, *Capnodium sp.* The mycilium of this fungus sometimes forms a felt over the leaf, closing the stomata and thus killing the tree.

On the spruces at Amherst, Mass., a scale less well known than this black-scale attracted the writer's attention late in May and in June, 1908. Large numbers of bees were humming in the trees on the campus of the agricultural college. At times the roar was suggestive of a swarm. At first, however, it was thought from the behavior of the bees that they were collecting materials for propolis, but none were seen with a burden packed upon their legs. By following a single bee it was possible to see her on a twig at the union of the last two years' growth searching with extended tongue for something apparently sweet. At the base of what looked to be a bud the bees invariably worked as eagerly as at a drop of honey. This bud-resembling structure was crushed and immediately revealed animal tissue. There were thousands of these bud-like scales on the spruces and from them the bees were busily collecting a liberal store of honey-dew. Some scales, however, apparently produced more of the substance than others, because in some instances globules or dried crystals of honey-dew were noticed at the base of the insects.

Specimens were sent to Mr. J. G. Sanders of the Bureau of Entomology, who determined the scale to be *Physokermes piceæ* Schr., "a European species

[3] Washington, 1901.

[1] Kellogg, Vernon L. 1905. American Insects. New York, Henry Holt & Co. VIII+674 pp. Page 187.

which affects the spruce trees and only recently has been introduced into the United States."[2]

The species is not likely to become a serious pest to the spruces, Mr. Sanders wrote, because of its numerous parasites. Consequently, bee-keepers will probably not be greatly annoyed with the honey-dew it produces as compared with the large amounts from aphids.

During the past summer (1909) the amount of aphid honey-dew stored by bees has been almost unprecedented in all localities east of the Mississippi, and especially northward. Reports in the apicultural periodicals show excessive production in Illinois, Indiana, Ohio, southern Michigan, Pennsylvania, New Jersey, Maryland and to some extent in New York and New England. In an editorial in *Gleanings in Bee Culture*[3] Mr. E. R. Root states: "The abundance of honey-dew [and the resulting admixture with pure honey] will make the year 1909 the shortest on a strictly clear white honey, east of the Mississippi and south of the Great Lakes, that we have ever known." He further adds: "Reports continue to pour in, showing that this is probably the greatest year for honey-dew ever known in this country."

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[2] To his knowledge, it has been taken at three points in Massachusetts.

[3] Vol. 37, Oct. 1, 1909, p. 388.

JOURNAL OF ECONOMIC ENTOMOLOGY PUBLISHING COMPANY

The annual meeting of the stockholders of this company will be held on December 28th or 29th in connection with the Association of Economic Entomologists, at Boston, Mass. The precise time and place will be announced at the sessions of that association. Members of the Advisory Board are hereby notified that it devolves upon them to nominate the elective officers.

E. P. Felt, *President*.
E. Dwight Sanderson, *Secretary*.

JOURNAL OF ECONOMIC ENTOMOLOGY

OFFICIAL ORGAN AMERICAN ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

DECEMBER, 1909

The editors will thankfully receive news items and other matter likely to be of interest to subscribers. Papers will be published, so far as possible, in the order of reception. All extended contributions, at least, should be in the hands of the editor the first of the month preceding publication. Reprints of contributions may be obtained at cost. Minor line figures will be reproduced without charge, but the engraving of larger illustrations must be borne by contributors or the electrotypes supplied. The receipt of all papers will be acknowledged.—EDS.

The forthcoming annual meeting of this Association promises to be one of absorbing interest to the economic entomologist. The program is literally crowded with valuable papers and the exhibit of entomological material and methods cannot fail to stimulate interest and lead to further improvements. A large attendance is assured and the mutual interchange of ideas which will result must have a marked influence on the science which we are all striving to advance. The benefits to be derived from participating in such meetings are more than personal; the member who attends receives first-hand information much of which he can transmit directly to his constituents for their own use in preventing loss from destructive insects. Thus the whole country, doubtless without realizing the fact, profits by these conventions.

Each year the Association had made a steady growth both in numbers and in the influence that it has exerted. The meetings have been characterized by harmony and unity of purpose and the future gives promise of even greater achievements than those that have characterized its progress in the past.

The JOURNAL OF ECONOMIC ENTOMOLOGY has proved its usefulness and at the end of the second year of its existence has become a firmly established and well supported publication.

All these facts should be a source of gratification to the members and should inspire all to unite in a common purpose to build up and develop the Association along practical and progressive lines.

Reviews

A MERITORIOUS WORK

F. V. Theobald has just published a very extensive work of 550 pages, profusely illustrated, on "The Insect and Other Allied Pests of Orchard, Bush and Hothouse Fruits." This work is so important that it should be in the hands of every economic entomologist in the United States, and more especially so as American economic entomologists should keep thoroughly informed regarding the injurious insects of neighboring countries, which are liable at any time to be accidentally imported into the States. The price is thirty shillings and orders should be sent to the author at Wyecourt, Wye (Kent), England.

L. O. HOWARD.

Insects Affecting Vegetables, by C. J. S. BETHUNE, Ont. Dep't. of Agric. Bull. 171, p. 1–64, 1909.

This very practical bulletin by a veteran in economic entomology gives brief accounts of the more common insects affecting garden vegetables, preventive and remedial measures being emphasized. The value of this publication is greatly increased by a similar discussion of fungous diseases and by directions for preparing the standard insecticides and fungicides. It can not but be most helpful to the readers for whom it is designed.

Spring Manual of Practice in Economic Zoology, by H. A. GOSSARD, O. Agric. Exp't. Sta. Bull. 198, p. 15–88, 1909.

This is the second in a series of important bulletins designed to assist the farmer in controlling not only insects but other animal pests and fungous diseases. The value of correct management, such as rotation of crops, clean farming, etc., is rightly emphasized at the outset. This is followed by brief discussions of various wild animals and methods of controlling the same. Special attention is given to birds. There are brief notes on the habits of the more important species and several paragraphs are devoted to a discussion of methods of attracting birds. Under farm treatment, the methods of controlling the various enemies of different crops are given in a summarized form. The discussion of methods to be employed with each important farm crop or group of crops is nicely summarized in tabular form. The author uses the season and crop as a starting point from which the farmer is expected to recognize the insect and select the proper treatment. The identification of some of the more important species is rendered more easy by a series of original illustrations. An appendix gives the records of bird migrations for the past fifteen years, with brief notes upon their habits. This latter should arouse more interest in bird life. It is a most serviceable publication.

Fourth Annual Report of the Superintendent for Suppressing the Gipsy and Brown-Tail Moth, by L. H. WORTHLEY, p. 1–75, 1909.

The magnitude of this work is well shown by the expenditure on the part of the state and some ninety-four infested cities and towns, comprising an

area of more than 5,0000 square miles, of over $500,000. In addition to this the federal government kept the trees and shrubs along some 230 miles of road free from these pests. Though this work is all conducted under the supervision of state authorities, the parties responsible are able to report that the insects have been kept under control, except in woodland districts, where lack of funds made extensive operations impossible. The clearing of trees along the streets and highways has been continued and a special effort made to coöperate with residents along the north shore, additional funds for this latter work being contributed largely by interested citizens and municipalities. The map of the infested area shows that in spite of this enormous expenditure the gipsy moth has been able to extend its range somewhat, while the brown-tail moth has established itself throughout the eastern half of the state. The extensive spraying operations have resulted in the development of an improved and more powerful oufit, especially adapted to woodland work. Experiments continued from the previous year have shown that solid plantings of white pine are not injured by gipsy moth provided they are protected from invasion by caterpillars from adjacent trees. The work on fungous diseases and parasitic insects has been continued. Dr. J. P. Clinton of Connecticut made special studies of the fungous disease affecting brown-tail moth caterpillars, and though his work did not result in establishing a wide-spread infection, this disease was found to be an important factor in controlling this pest. The work with parasites has been greatly increased, some especially valuable forms having been imported from Japan through the agency of Professor Kincaid. Importations of parasites have been larger than before, and some 200,000 of the most active enemies of the gipsy and brown-tail moths were liberated. The extended work with parasites resulted in a number of important discoveries. Doctor Howard and his associates are to be congratulated upon the progress already made in this most promising line of work. We would call attention, in conclusion, to Professor Silvestri's report upon his findings in the infested territory. This Italian specialist highly commends the careful biological work on parasites now being done in Massachusetts and rightfully calls attention to the importance of similar studies under European conditions, because such investigations would prove of great value in determining the relative importance of the various species.

Orchard Spraying—Orchard Protection Work, by FRANKLIN SHERMAN, JR., N. C. Dep't. of Agric. Bull. 6, Vol. 30, p. 1–48, 1909.

This is a very plain, practical bulletin designed especially for farmers not well versed in horticulture. The author does not hesitate to go into such details as the type of spray apparatus, the purchasing of chemicals and the relative benefits to be secured from spraying. The orchard inspection work in the state is briefly summarized and pertinent suggestions made to purchasers of nursery stock. The bulletin is illustrated by a series of original figures and will appeal most strongly to the practical man.

Insect Stories, by VERNON L. KELLOGG, Henry Holt & Co., p. 1–298, illustrated, 1909.

This interesting little book portrays in a simple though effective manner some of the instructive lessons that may be learned by a study and collection

of some of our common insects in the field. It bears directly on nature study of insects, which has been considerably neglected in the past, and should appeal to many youthful readers in such a manner as to direct their attention and arouse their interest in the fascinating study of entomology in the field.

Twenty-Fourth Report of the State Entomologist, 1908, by E. P. Felt, New York State Museum Bulletin 134, p. 1–206, 22 fig., 17 pl.

This report discusses the most prominent features concerning economic species in New York State during the year 1908. Among the insects treated at length are the poplar sayfly, the grape blossom midge, concerning which biological notes as well as technical descriptions of the adults and larvæ are given, the gladioli aphid (Aphis gladioli) a new species found attacking this host, the green cockroach, a central American form which was found in the state during the year, and the common house fly which is considered at some length, including a bibliography of the publications on the species. A list of the publications of the entomologists office and a statement of the donations received is also included. The appendix contains an article by James G. Needham, relative to a peculiar new May fly, in which a new genera and two new species are described, and a Catalogue of the described species of Scolytidæ of America, North of Mexico, by J. M. Swaine. The text is well illustrated by figures and plates and provided with a complete index. This valuable publication should be in the library of every working entomologist.

Contributions Towards a Monograph of the Scolytid Beetles. I. The Genus Dendroctonus, by A. D. Hopkins, U. S. Dept. Agric., Bur. Ent. Tech. Series, Bull. 17, Part 1, p. 164, pl. 8, fig. 95 (June 30, 1909).

Practical Information on the Scolytid Beetles of North American Forests. I. Bark Beetles of the Genus Dendroctonus, by A. D. Hopkins, U. S. Dept. Agric., Bur. Ent. Bull. 83, Part 1, p. 169, pl. 2, fig. 102 (Oct. 11, 1909).

These two bulletins, which supplement each other in an admirable manner—the former containing the more technical, or purely scientific matter relating to the species of the genus *Dendroctonus*, the latter the facts and suggestions of economic interest—together constitute the most important contribution hitherto made to the study of the Scolytidæ in this country. They are, moreover, one of the best examples of the high standards that are being maintained by the Bureau of Entomology in the scientific investigation of our insect pests. In this respect Dr. Hopkins' work may, indeed, be regarded as a model not only for all future investigations of the Scolytidæ, but also of many other groups of insects. Confronted with a genus of beetles of very difficult taxonomic affinities and immense practical importance, he has undertaken his task with a truly German "Gründlichkeit" and breadth of view. Before describing the twenty-four known species of the genus he gives a fine account of the external anatomy of *Dendroctonus valens*, the red turpentine beetle, one of the largest

species of the genus. This account is a contribution to the morphology both of the Scolytidæ in particular and of the Coleoptera in general. Then follow remarks on the geographical distribution, ethological peculiarities (Dr. Hopkins unfortunately prefers the words "physiological" and "bionomic"), the range and limits of specific variation, progressive modifications within the genus and the coniferous host-trees that are infested by the *Dendroctoni*. More than half of the technical bulletin is devoted to a minute and orderly account of the species, their galleries, or excavations, broods, distribution, and seasonable relations, with a full synonymy and bibliography, making one of the most complete monographs ever published of a single small genus of insects. The bulletin containing the matter of economic importance is equally full and explicit. It embodies a great number of excellent suggestions for the forester and abounds in careful observations, the result of a practical experience extending over many years. The author gives a number of striking instances of the control of *Dendroctonus* depradations through attending to the proper time for beginning and ending timber-cutting or for barking operations in our coniferous forests. He shows how success in controlling the beetles must depend on a precise knowledge of their developmental and seasonal peculiarities. Considerable space is devoted to an account of the diseases and natural enemies of the *Dendroctoni*. Then the species are taken up *seriatim* and the seasonal history of each is given in detail, with an exhaustive account of its economic features and a minute résumé of its bibliography and the basis of information concerning its habits. The clear and profuse illustrations leave nothing to be desired. The student of forestry entomology will find it advantageous to bind both bulletins together so that they can be used as a hand-book. The only criticism that may be offered is that the author should have prefaced the technical study, which appears as the first of a series, with a brief account of the Scolytidæ in general. Such an introduction would have been a great aid to the American student and would place the genus so exhaustively treated in its proper perspective with relation to the other genera of the family. This, however, is a rather unimportant omission. All entomologists will congratulate Dr. Hopkins on his fine achievement and desire that he may have the leisure and inclination to give us many similar studies of other Scolytid genera.

W. M. WHEELER.

Third Annual Report of the Committee of Control of the South African Central Locust Bureau, by CHARLES P. LOUNSBURY, Cape Town, South Africa, p. 60 (1909).

The report outlines the work that have been done during the past year in controlling the locust plague by the different governments in South Africa and includes the proceedings of the annual meeting at Cape Town, which was attended by the representatives of most of the districts which are suffering severe loss from these insects. The officials concerned are to be congratulated on the united and systematic efforts that are being made to check the ravages of these pests.

Current Notes

Conducted by the Associate Editor

Dr. A. W. Morrill, who was recently appointed entomologist to the Arizona Horticultural Commission and the Arizona Agricultural Experiment Station, has moved his headquarters from Tucson to Phœnix, Arizona, and all communications should be sent to him at the latter address.

Mr. F. D. Couden has resigned his position with the Bureau of Entomology at Washington, D. C., and entered a partnership with Mr. Herbert W. Meyers under the firm name of Meyers & Couden. All communications should be sent to No. 432 Pioneer Building, Seattle, Washington.

Mr. Harry Severin, who recently received a post-graduate degree at the Ohio State University, has been appointed State Entomologist of South Dakota. Address, Brookings, S. D.

Dr. A. E. Brunn died at South Woodstock, Conn., September 30, 1909. He was a graduate of Cornell University and was greatly interested in entomology, having published in 1882 a valuable paper on the Tineidæ infesting apple trees at Ithaca, N. Y.

Mr. C. H. T. Townsend, who has been engaged in investigation work on the Tachinidæ at the Gipsy Moth Parasite Laboratory at Melrose Highlands, Mass., has been granted leave of absence by the Bureau of Entomology in order to carry on entomological investigations for the Peruvian government. He will establish an entomological service in that country and will give special attention to the treatment of insects affecting cotton and fruit trees. Great damage has recently resulted to these crops on account of the abundance of certain scale insects and these will be given immediate attention. Address, Lima, Peru.

Mr. Arthur I. Bourne, a graduate student at the Massachusetts Agricultural College, was employed as assistant in the entomological department of the Connecticut Agricultural Experiment Station at New Haven during the summer. Mr. Bourne has recently been appointed an expert and agent of the Bureau of Entomology, Washington, D. C.

Mr. George H. Hollister, who for three years has been field superintendent in immediate charge of the gipsy moth work at Stonington, Conn., has accepted an appointment as forester in Keney Park, Hartford, Conn. Mr. Hollister took up the work in his new position October 16th, where he will have charge of all spraying and planting work in a seven hundred acre park, which is well endowed.

Mr. E. J. Kraus, who recently resigned from the Bureau of Entomology, accepted an appointment as Assistant in Horticulture at the Oregon Agricultural College, Corvalis, Oregon. An error was made in announcing his change of address in a recent issue.

Dr. H. J. Franklin will have charge of the Cranberry sub-station of the Massachusetts Agricultural Experiment Station at Wareham, Mass., where he will conduct extensive experiments on insects affecting that crop.

Mr. S. A. Rohwer, who was Assistant in Zoölogy and Botany in the University of Colorado, has been appointed an Agent and Expert in the Bureau of Entomology, Washington, D. C.

Mr. Myron H. Swenk, who for several years has been Assistant Entomologist of the Nebraska Agricultural Experiment Station, has been appointed Adjunct Professor of Entomology at the University of Nebraska.

The Division of Insects of the United States National Museum has moved to its new quarters in the new museum building, which is rapidly nearing completion. The rooms assigned are on the top floor of the building and for the first time in many years enough space is available to provide the specialists with comfortable working room and to allow the large and valuable collections to be readily available for consultation and study as well as to permit of their further growth. The building is fireproof and most of the collections have been transferred to trays that are kept in fireproof steel cases. This insures the safety of type material, which will be greatly appreciated by all working entomologists.

The Exhibit of Economic Entomology of the Bureau of Entomology, which has been displayed at the Yukon-Alaska Exposition at Seattle, Washington, this summer, has been packed and shipped in two sections. One section has been sent to the United States Land and Irrigation Congress at Chicago and the other to the National Corn Exposition at Omaha, Nebraska.

Mr. Fred Maskew has resigned from the Bureau of Entomology to become Assistant Superintendent of the California State Insectary at Sacramento, California.

Mr. E. A. Schwarz and Mr. F. C. Bishopp of the Bureau of Entomology are in Mexico collecting and making investigations of the ticks of that country.

Mailed December 22, 1909.

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TWENTY-SECOND ANNUAL MEETING

ASSOCIATION OF ECONOMIC ENTOMOLOGISTS

Boston, Mass., December 28–29, 1909

The twenty-second annual meeting of the American Association of Economic Entomologists will be held at Boston, Mass., on Tuesday and Wednesday, December 28 and 29, 1909. The sessions will open at 10 a. m. Tuesday at the Harvard Medical School, Brookline, Mass. (ten minutes' ride on the electric cars from hotel headquarters). The afternoon session will begin at 1 p. m. and the meetings on the following day will be at the same hours.

Other Meetings

The American Association for the Advancement of Science and its affiliated sociates will hold meetings throughout the week. The meetings of the sections on zoölogy and botany will be held in the same group of buildings as the meetings of this Association.

The Association of Horticultural Inspectors will hold its meeting on Monday, December 27, at 2 p. m. and 7. 30 p. m.

The Entomological Society of America will meet on Thursday and Friday, December 30 and 31.

Exhibits

An extensive exhibit will be made of New England insects, also a special display of equipment and devices for rearing and distributing beneficial species and for treating noxious ones in the field. An exhibit will be made illustrating different phases of the gypsy and brown-tail moth work, and one will be sent from the Ohio Agricultural Experiment Station of insects which are placed on exhibition at state and county fairs for educational purposes.

The information and new ideas that may be secured by carefully examining the exhibits will fully repay any entomologist for attending the meeting.

Hotel Headquarters

The hotel headquarters of this Association and of the Association of Horticultural Inspectors will be at the Copley Square Hotel, Huntington Avenue and Exeter Street, where a rate of $1.50, and upwards, a day has been secured. Members arriving over the Boston & Albany (New York Central) or New York, New Haven & Hartford Railroads should leave their trains at "Huntington Avenue" or "Back Bay"

stations, respectively. These stations are within one block of our hotel headquarters.

Members are advised to secure reservation of rooms in advance, as there will be a large attendance at the meeting.

Railroad Rates

The following information concerning railroad rates has been furnished through the courtesy of Dr. L. O. Howard, Permanent Secretary of the American Association for the Advancement of Science:

A railroad rate of one fare and three-fifths for the round trip, on the certificate plan, has been granted by the Eastern Canadian, the Central and the New England Passenger Associations (not including the Eastern and the Metropolitan Steamship companies), and by the Trunk Line Association. Decision has not yet been received from the Southeastern Passenger Association.

The Southwestern Passenger Association offers no special rate, but suggests that members from Texas, Louisiana, Arkansas, Oklahoma and Southern Missouri purchase tickets to the eastern gateways of the Southwestern Association, and repurchase from such points at the reduced fares authorized therefrom.

From the States of California, Nevada, Oregon, Washington and west of, and including, Mission Junction, B. C.; also from what are known as Kootenay common points, namely, Nelson, Rossland, Sandon, Kaslo and Grand Forks, B. C., the Transcontinental Passenger Association has on sale daily Nine Months' Tourists Fares, approximating two cents per mile in each direction, or about one fare and one-third for the round trip. The nine months' fares apply to the eastern gateways of the Transcontinental territory, and station agents will cheerfully advise delegates as to the eastern points to which it will be most advantageous for them to purchase nine months' tickets in rebuying through to Boston.

The Western Association has on sale revised one-way fares in effect to Chicago, Peoria and St. Louis, with the understanding that persons can repurchase from these points and take advantage of any reduced fares that may be authorized therefrom. The fares to Chicago, Peoria and St. Louis from a large part of the Western Passenger Association territory are now on the basis of two cents per mile; hence, with the reduced fares from the three cities named, the net rate amounts practically to a rate of fare and three-fifths for the round trip.

The following directions are submitted for your guidance:

1. Tickets at full fare for the *going* journey may be secured within three days prior to and during the first three days of the meeting. The advertised dates of the meeting are December 25, 1909, to January 1, 1910, consequently you can obtain your tickets not earlier than December 22, 1909, and not later than December 27, 1909.

From points located at a great distance, from which it takes more than three days to reach Boston, going tickets may be purchased on a date which will permit members to reach Boston by December 25, 1909.

2. Present yourself at the railroad station for ticket and certificate at least thirty minutes before departure of the train.

3. Certificates are not kept at all stations. If you inquire at your station

you will find out whether certificates and through tickets can be obtained to the place of meeting. If not obtainable at your home station, the agent will inform you at what station they can be obtained. You can in such case purchase a local ticket thence, and there purchase through ticket and secure certificate to place of meeting. Be sure that, when purchasing your going ticket, you request a *certificate*. *Do not make the mistake of asking for a receipt.*

4. On your arrival at the meeting present your certificate to Mr. F. S. Hazard, Assistant Secretary, American Association for the Advancement of Science. It has been arranged that the special agent of the New England Passenger Association will be in attendance at the office of the Permanent Secretary to validate certificates daily (9 a. m. to 6 p. m.) from Tuesday, December 28, 1909, to Saturday, January 1, 1910, both dates inclusive. *A fee of 25 cents will be charged at the meeting for each certificate validated.* If you arrive at the meeting and leave for home prior to the special agent's arrival, or if you arrive at the meeting later than January 1, after the special agent has left, you cannot have you certificate validated, and consequently you will not get the benefit of the reduction on the home journey. *No refund of fare will be made on account of failure to have certificate validated.*

If the necessary minimum is in attendance, and your certificate is duly validated, you will be entitled, up to and including January 5, 1910, to a continuous passage ticket to your destination via the route over which you made the going journey, at three-fifths of the limited fare.

Program

Report of the Secretary.

Report of the Committee on Nomenclature, by Mr. Herbert Osborn, Chairman, Columbus, O.

Report of the Committee on Testing Proprietary Insecticides, by Mr. E. D. Sanderson, Chairman, Durham, N. H.

Report of the Committee on Affiliation, by Mr. Lawrence Bruner, Chairman, Lincoln, Neb.

Report of the Executive Committee, by President W. E. Britton, New Haven. Conn.

Appointment of committees.

Miscellaneous business.

New business.

Annual address of the President, by Mr. W. E. Britton, New Haven, Conn., "THE OFFICIAL ENTOMOLOGIST AND FARMER."

Reading of Papers

"THE MAKEUP AND VALUE OF EXHIBITS AT STATE AND COUNTY FAIRS," by H. A. Gossard, Wooster, O. (15 minutes.)

Illustrated by the Ohio Exhibit. Discussion of the value of such exhibits to the work of the economic entomologist. Inventory of the exhibit, discussion of its separate features, devices for shipping, etc.

"A First Course in Economic Entomology," by E. B. Lowe, Detroit, Mich. (15 minutes.)

The ground it should cover, where it should lead, etc.

Adjournment.

Program

Tuesday, December 28, 1 p. m.

Discussion of the Presidential Address.

Reading of Papers

"Observations on the House Fly," by E. P. Felt, Albany, N. Y. (15 minutes.)

"Controlling the Black Fly in the White Mountains," by E. D. Sanderson, Durham, N. H. (15 minutes.)

Experiments in the destruction of the larvæ.

"The Present Condition of the Gypsy and Brown-Tail Moth Work in Massachusetts," by F. Wm. Rane, Boston, Mass. (15 minutes.)

"Report of the Season's Work on Arsenical Injury to Fruit Trees," by E. D. Ball, J. E. Greaves and E. G. Titus, Logan, Utah. (10 minutes.)

All of the principal apple-growing sections west of the Rocky Mountains were visited, the orchards examined and the soil tested; notes on the findings and experiments undertaken to test the effect of arsenic on trees, with report of progress.

"A New Arsenical Poison for the Codling Moth," by C. P. Gillette, Fort Collins, Col. (10 minutes.)

The results of a brief test of sulfid of arsenic for controlling the codling moth.

"Some Insecticide Methods Used in Combatting the Gypsy Moth," by A. F. Burgess, Washington, D. C. (15 minutes.)

A report on some of the methods used, with remarks concerning their value for fighting other insect pests.

"Some New Facts in Regard to the Lime-Sulfur Solution," by H. A. Surface, Harrisburg, Penn. (15 minutes.)

The different brands of commercial lime-sulfur solution are of different strengths. These were analyzed chemically and the composition of each is given, showing how much each should be diluted to be equal to the standard formula.

Carbonic acid gas used as a power for spraying precipitates the dissolved sulfur. Chemical analyses were made of different samples under this gas pressure, and the results are shown.

Causes are shown for different colors of the lime-sulfur solution.

"Studies in Insecticides," by F. B. Lowe, Detroit, Mich. (15 minutes.)

Results of recent work with insecticides.

"Results of Recent Experiments in the Use of Hydrocyanic Acid Gas for Fumigation Purposes," by R. S. Woglum, Washington, D. C. (15 minutes.)

"Carbon Disulfid Fumigation for the Rice Weevil in Corn," by W. E. Hinds, Auburn, Ala. (12 minutes.)

A brief discussion of the results of investigations along this line upon both small and large scales.

"Notes on the Oyster Shell Scale in Montana," by R. A. Cooley, Bozeman, Mont. (10 minutes.)

"Notes on the 'Cigarette Beetle'," by P. H. Hertzog, Lewisburg, Penn. (10 minutes.)

Extent of injury. Fumigation results. Other devices for fighting it and results.

"Collembola as Injurious Insects," by Walter E. Collinge, Uffington, Berkhamsted, England. (7 minutes.)

Illustrates the part they play as carriers of plant diseases by means of the spores of fungi which become attached to their bodies, quite apart from their own depredations due to feeding.

Adjournment.

Program

Wednesday, December 29, 10 a. m.

Reading of Papers

"The Relation of Temperature to the Growth of Insects," by E. D. Sanderson, Durham, N. H. (15 minutes.)

An account of experiments in rearing various insects at different temperatures and a discussion of their theoretical import.

"A Constant Low Temperature Apparatus for Biological Investigations," by E. C. Cotton, Knoxville, Tenn. (15 minutes.)

Description of a plant recently installed at the Tennessee Agricultural Experiment Station, designed to secure and maintain constant low temperatures for the study of problems connected with the life history of the North American Fever Tick. (Illustrated with lantern slides.)

"The Larch Saw Fly (Nematus erichsonii)," by C. Gordon Hewitt, Ottawa, Canada. (10 minutes.)

"The Unprecedented Appearance of the Saddled Prominent (Heterocampa guttivitta) in Maine," by E. F. Hitchings, Waterville, Me. (15 minutes.)

(Illustrated with lantern slides.)

"Notes on the Corn Ear Worm," by T. J. Headlee, Manhattan, Kan. (15 minutes.)

Two years' study of life history and habits.
Time of planting as a means of preventing the injury it does.

"Notes on Aphis madiradicis," by George G. Ainslie, Clemson College, S. C. (10 minutes.)

A short review of observations and facts gathered in connection with the work on this insect in South Carolina in 1909.

"Notes upon the Life History of Contarina sorghicola Coq," by Harper Dean, Jr., Washington, D. C. (5 minutes.)

A synopsis of the results obtained from a two-year study of this insect in Louisiana and Texas.

"The Cause of Sugar Beet 'Blight'," by E. D. Ball, Logan, Utah. (10 minutes.)

Serious injury from curly leaf or "blight" was found this season in California, Oregon and Idaho, and the fact that the beet leaf hopper was the cause of the serious loss in California some years ago was definitely established. Notes on distribution, food plants and probable areas of frequent injury are given.

"Hibernation of Pemphigus betae," by R. A. Cooley, Bozeman, Mont. (10 minutes.)

"Some Preliminary Investigations of Epitrix cucumeris," by S. Arthur Johnson, Fort Collins, Col. (10 minutes.)

"The Development of Stictonotus isosomatis and Eupelmus allynii," by E. O. G. Kelly, Washington, D. C. (5 minutes.)

The life history and host of these parasites and their economic importance.

"Insectivorous Insects in the Insectary and the Field," by F. B. Lowe, Detroit, Mich. (15 minutes.)

Observations and brief résumé of some experiments.

"Notes on Calosoma frigidum, a Native Beneficial Insect," by A. F. Burgess, Washington, D. C. (7 minutes.)

Notes on the range of the insect, with remarks on its unusual abundance in sections of New Hampshire, which were defoliated by the Saddled Prominent (*Heterocampa guttivitta*) during the summer of 1909.

Adjournment.

Program

Wednesday, December 29, 1 p. m.

Reading of Papers

"SOME NOTES ON THE GEOLOGICAL HISTORY OF THE PARASITIC HYMENOPTERA," by Charles T. Brues, Boston, Mass. (15 minutes.)

Some data which bear on the understanding of the group, the relationships of recent faunae and their usefulness in practical entomology.

"THE ERMINE MOTHS," by P. J. Parrott, Geneva, N. Y. (15 minutes.)

A discussion of the discovery of a species on imported seedlings and of the economic importance of the insect.

"FURTHER OBSERVATIONS ON THE APPLE LEAF HOPPER (EMPOASCA MALI) AND NOTES ON P. NITELA AND P. CATAPHRACTA," by F. L. Washburn, St. Anthony Park, Minn. (15 minutes.)

"NOTES ON THE LIFE HISTORY OF FIDIOBIA FLAVIPES ASH., AN EGG PARASITE OF THE GRAPE ROOT WORM (FIDIA VITICIDA WALSH)," by A. G. Hammar, Washington, D. C. (10 minutes.)

"METHODS USED IN REARING THE GRAPE ROOT WORM (FIDIA VITICIDA WALSH) AND THE CODLING MOTH (CARPOCAPSA POMONELLA L.)," by A. G. Hammar, Washington, D. C. (10 minutes.)

"SPRAYING FOR THE CODLING MOTH," by E. P. Felt, Albany, N. Y. (10 minutes.)

"WORK ON THE APPLE MAGGOT," by W. C. O'Kane, Durham, N. H. (6 minutes.)

A summary of the work undertaken in New Hampshire to determine unknown points in the life history and habits of *Rhagoletis pomonella*, and to test certain proposed means of control.

"NOTES ON THE 10-LINED POTATO BEETLE IN MONTANA," by R. A. Cooley, Bozeman, Mont. (10 minutes.)

"INSECTS NOTABLY INJURIOUS IN LOUISIANA DURING 1908–'09," by Arthur H. Rosenfeld, Baton Rouge, La. (5 minutes.)

"SOME INSECTS OF THE YEAR IN CANADA," by Arthur Gibson, Ottawa, Canada. (10 minutes.)

"INSECT NOTES FROM ILLINOIS FOR 1909," by John J. Davis, Urbana, Ill. (10 minutes.)

Notes on injurious insects occurring in the State during the past year.

"NOTES FROM NEW HAMPSHIRE FOR 1909," by E. D. Sanderson, Durham, N. H. (10 minutes.)

Reports of committees.
Miscellaneous business.
Election of officers.
Fixing time and place of the next meeting.
Adjournment.

EIGHTH ANNUAL MEETING
ASSOCIATION OF HORTICULTURAL INSPECTORS

Boston, December 27th, 1909

First Session, Monday, 2 p. m.

Program

Organization.

Remarks by the President, Prof. F. L. Washburn, St. Anthony Park, Minn.

Report of the Committee on General Principles Governing the Association, Dr. J. B. Smith, Chairman, New Brunswick, N. J.

Report of the Committee on National Law, Prof. T. B. Symons, Chairman, College Park, Md.

"THE BROWN-TAIL MOTH ON IMPORTED NURSERY STOCK," Prof. G. G. Atwood, Albany, N. Y.

"REMARKS ON EUROPEAN CONDITIONS AS AFFECTING IMPORTED NURSERY STOCK," Dr. L. O. Howard, Washington, D. C.

"REVIEW OF THE OKLAHOMA NURSERY INSPECTION LAWS AND THEIR EFFECT," Prof. C. E. Sanborn, Stillwater, Okla.

Evening Session, 7.30 p. m.

"WHAT SHOULD BE THE NATURE OF OUR CERTIFICATES OF NURSERY INSPECTION?" Prof. Franklin Sherman, Jr., Raleigh, N. C.

"RESULTS OF VARIOUS REMEDIES FOR SAN JOSE SCALE, BY PENNSYLVANIA ORCHARDISTS, AS SEEN BY THE INSPECTORS IN THE ORCHARDS," Prof. H. A. Surface, Harrisburg, Pa.

"SOME OBSCURE PEACH DISEASES," Prof. J. B. S. Norton, College Park, Md.

"INCREASING THE DEMAND FOR ORCHARD INSPECTION," Mr. N. E. Shaw, Columbus, Ohio.

"LOCAL INSPECTION, PUBLIC SPRAYERS, AND THE OSAGE ORANGE HEDGE," Prof. T. B. Symons, College Park, Md.

Questions for Discussion

1. Mail shipments of nursery stock: Is it desirable to endeavor to discontinue this practice?

2. What means can be taken to require the railroad officials to be more strict in demanding certificates when accepting nursery stock for transportation?

3. In view of the fact that there is a demand from growers of nursery stock for relief from destroying slightly infested trees—

Is it desirable to permit spraying of young trees?

If so (*a*) with what formula?

(*b*) How long should such treated trees stand in nursery before final inspection and sale?

4. Are scale marks to be considered prima facie evidence of infestation?

5. Should not nurserymen be required to fumigate all buds and cions, and by what formula?

6. How can we prevent the scale from entering the nursery?

7. What further can be done to control spread of San José scale in nurseries and commercial orchards?

8. Shall we have a law compelling spraying?

9. What shall be done for the owner after his orchard is inspected?

10. Is it desirable to eradicate scaly fruit trees from city lots, considering the cost and objections?

11. What is the attitude of official inspectors relative to permitting supposedly infested stock to be shipped and planted in areas that are generally infested with the San José scale?

12. Shall there be legislation against selling fruits infested with San José scale and the Codling Moth?

13. What are the arguments in favor of inspection and the control of peach yellows and little peach?

14. Should the sale of premature peaches be prohibited?

15. What is the present status of the Crown Gall on apple? How is such considered in issuing certificates?

16. What is new concerning blister rust of the white pines recently discovered?

17. In view of the present information on pear blight, what ought to be done to control the disease in commercial orchards?

18. Is it desirable to appoint a committee to draw an up-to-date list of insects and plant diseases likely to be disseminated on nursery stock?

19. Is it desirable to have a more regular organization of this Association or to consider affiliation with the Association of Economic Entomologists?

Election of officers.

Miscellaneous business.

Adjournment.

The meeting of the Association can be continued Wednesday evening, December 29, at 7.30 p. m., if desired by the members.

The headquarters and meetings of the Association will be at the Copley Square Hotel, corner Huntington Avenue and Exeter Street, Boston.

Report of the Committee on General Principles Governing the Association of Horticultural Inspectors

(Printed and distributed at the request of the Committee in order that the members of the Association may give the report some consideration previous to the meeting.)

1. The first and principal duty of the horticultural inspector is to his constituents, the farmers and fruit growers of his State.

2. Inspection, quarantine and similar laws are passed for the protection of these interests, and so far as the inspector is charged with the enforcement of the laws he must keep in mind always their purpose, no matter what the effect may be on other interests.

3. The inspector owes the nurserymen whose stock he inspects fair treatment and all the consideration that the law allows him to accord, but nothing else.

4. The inspection laws, although meant primarily to protect the horticultural and agricultural interests, are not intended to injure the nursery interests, and they should never be made to bear any more severely u on growers of stock than is absolutely necessary.

5. Between the honest nurseryman and the inspector there should be coöperation and an attitude of helpful interest on the part of the former.

6. The dishonest nurseryman, or one who wishes to dispose of questionable stock to avoid loss, deserves no consideration whatever.

7. The horticultural inspectors, as such, have no interest in having uniform inspection laws throughout the country; the situation in the different States varies so greatly that each State may well be allowed to judge of its own needs and to formulate its own policy, subject to the general provisions of the Federal constitution and laws.

8. The Association of Horticultural Inspectors is a voluntary one, and its members are bound by none of the actions taken at the meetings except as they approve themselves to their judgment.

9. The relation between the members is that of colleagues or comrades

engaged in efforts to the same end, under different conditions, seeking mutual help and information, by free conference at the meetings.

10. As colleagues, each member owes to every other member frankness, honesty and a belief that every man is doing the best he can under his circumstances, and that his certificates are honestly given, and state facts correctly.

11. Each member recognizes the possibility of error in his own work and in that of others, and recognizes also that the receipt of a parcel of infested stock bearing a certificate is not necessarily evidence of either carelessness or lack of proper system on the part of the inspector whose certificate is attached.

12. Each member, whenever he gets track of a parcel of infested stock bearing the certificate of a fellow member, owes it to that fellow member to notify him immediately of all the facts in the case, that an investigation may be made by the inspector concerned and a continued misuse of his certificate prevented.

13. Whenever any inspector has reason to believe that any nurseryman in his State is willing to run risks of shipping stock not suitable for interstate trade into another State, it is his duty to warn the inspectors of neighboring States into which he has reason to believe stock may be sent that stock from such nursery is open to suspicion.

14. It is the duty of every member of this Association to answer frankly and freely every question asked by a fellow member concerning nurseries or other conditions in his State, and it is the duty of the member so informed to consider this information as confidential and not for publication.

15. In case at any time a certificate be withdrawn or a nurseryman holding a certificate be detected in dishonest or questionable practice, notice of such withdrawal shall be at once sent to every other inspector within the region where such nurseryman is known to trade, and notice of such dishonest or questionable practice shall be given to all inspectors in States likely to be affected by such practices.

16. In this Association the rule that should govern all members is, Do unto the others as you would that the others should do unto you.

Submitted by the Committee:

John B. Smith, *Chairman.*
H. T. Fernald.
Avon Nelson.
Franklin Sherman, Jr.
F. L. Washburn.